7 MARINE ECOLOGY AND FISHERIES

7.1 Benthic Ecology

This chapter assesses the potential impacts on bethnic ecology in addition to providing recommendations for mitigation measures related to the proposed ferry development connecting Greenore Point Co. Louth in the Republic of Ireland with Greencastle in County Down, Northern Ireland.

The development consists of the construction of ferry berthing installations at Greenore and Greencastle, mainly within the intertidal and shallow sub-tidal areas at both locations. In addition, a hardstand vehicle queuing area would be located above the high-tide mark at each site.

7.1.1 Sensitivities within the benthic study area

7.1.1.1 Greenore Site

On behalf of RPS, Aquatic Services Unit (ASU) undertook a survey of the benthos and marine mammals in the area of a proposed ferry development at Carlingford Lough Co. Down.

The proposed landfall at Greenore, Co. Louth is located on the eastern side of Greenore Point, in Co. Louth. This location is within two protected areas – Carlingford Lough proposed NHA (IE000452) and Carlingford Shore SAC (IE002306).

The Carlingford Shore SAC and Carlingford Lough pNHA comprise the entire southern shoreline of Carlingford Lough and continue to the southern part of the Carlingford Peninsula. Although the principal conservation interests of the area lie in the shingle and sandy shoreline habitats, the site also includes intertidal sand and mudflats and saltmarsh communities. The area has very good examples of annual driftline vegetation and perennial vegetation of stony banks and shingle, which could potentially extend across the location of the proposed development as these are known to occur between Greenore and Cooley Point.

Several Annex I listed habitats are present along the Carlingford Shore SAC/Carlingford Lough pNHA. These include:

1140: Mudflats and Sandflats not covered by seawater at low tide
1210: Annual vegetation of driftlines
1220: Perennial vegetation of stony banks
1330: Atlantic Salt Meadows.

Intertidal and subtidal surveyed will be undertaken within and adjacent to the footprint of the proposed developments to identify the fauna and communities present, including any of the Annex I habitats identified above.

The main conservation objectives for the Carlingford Shore SAC are to maintain or restore the favourable conservation condition of the Annex I habitats for which the SAC has been selected: [1210: Annual vegetation of driftlines & 1220: Perennial vegetation of stony banks].

7.1.1.2 Greencastle Site

The proposed landfall location on the northern shore of Carlingford Lough is at Greencastle, Co. Down. The site at Greencastle is located within three specified protected areas

- Carlingford Lough Area of Special Scientific Interest (ASSI 103)
- Carlingford Lough Ramsar Site (UK12004)
- Carlingford Lough SPA (UK9020161)

The Carlingford Lough ASSI is known to contain a range of unusual and rich littoral communities. The lower beach at Cranfield Point, located approximately 2 ½ km to the east of the proposed development, holds the highest intertidal densities of the sea potato *Echinocardium cordatum*. In addition, large areas of Mill Bay, the south –eastern extent of which is located approximately 600m west of the proposed development on the Greencastle side, has several habitats and biological communities of interest. Large areas of this Mill Bay consist of a unique community association for Northern Ireland of a boulder based fucoid community superimposed on a wide mud and sand dominated intertidal flat. In addition, three out of four major intertidal sedimentary communities found in Northern Ireland are present in Mill Bay. In addition, large areas of saltmarsh are present along the upper reaches of Mill Bay, and these habitat types are considered rare and under threat in Northern Ireland due to grazing pressure, erosion or commercial development. In addition, the Mill Bay area supports the largest remaining intact block of saltmarsh in Northern Ireland. A 1½ km stretch of intertidal north from Killowen Point consists of a sheltered boulder shore, very rich in invertebrate species. This is the only example of this type of community present in Northern Ireland, outside of Strangford Lough.

In addition, the site is situated within the Carlingford Lough Ramsar site (UK12004) and the Carlingford Lough SPA (UK9020161), both classified under the EC Directive 79/409 on the conservation of wild birds.

The footprint of the development will be outside of all of the sensitive intertidal habitats listed above.

7.1.2 Benthic Baseline Surveys

The current survey was undertaken to assess the marine biological communities present in the area and determine the potential impacts of the proposed development on these communities. This assessment involved the completion of field assessments of both the intertidal and subtidal within the immediate vicinity of the proposed ferry infrastructure at both Greencastle and Greenore. The ferry route is shown below (Figure 7.1).

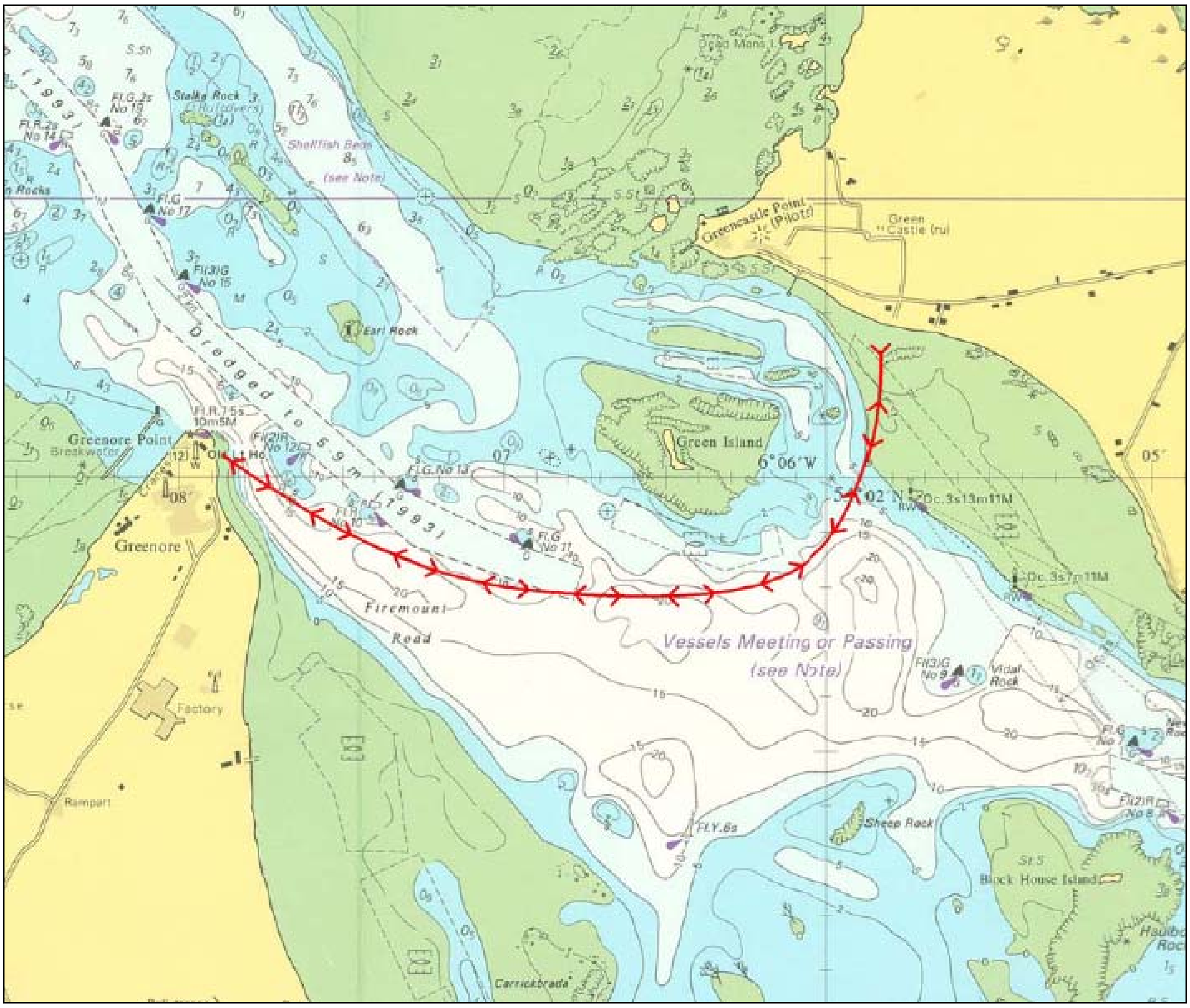


Figure 7.1: Approximate Location of Ferry Development and Ferry Route at Greenore and Greencastle

7.1.3 Methodology

7.1.3.1 Impact Assessment Guidelines

Impact assessment has been undertaken with due regard to the Environmental Protection Agency (EPA)Advice Notes on Current Practice (2003); the EPA Guidelines on the information to be contained in Environmental Impact Statements (2002). The approach taken also broadly follows guidelines for ecological impact assessment in marine and coastal area (IEEM, 2010).

Criteria for assessing impact level have been derived from those set out in Appendix 4 of the NRA discipline specific Ecological Impact Assessment (EcIA) Guidelines (2009). Terminology for impact significance and duration follows that set out by the EPA (2003) in its generic guidelines.

7.1.3.2 Intertidal Hard Benthos Survey

A walk-over survey was undertaken of the Greenore and Greencastle study areas during a spring tidal cycle on March 6th and 7th 2012 in order to assess the nature of the habitats within and adjacent to the proposed ferry installations. Observations were made over a high-low tidal cycle at both sites. At Greenore the walk over survey covered 400m of coastline whereas on the Greencastle side it covered just under 700m.

The principal substrates and habitats were described and in areas of hard benthos (rock), transects and/or quadrats (0.5m x 0.5m) were surveyed to record the cover of the main attached marine seaweeds and invertebrates (Table 7.1 and Figures 7.2 & 7.3). Representative photos covering the main intertidal features are presented in Appendix 7.1.

Table 7.1: Positions of intertidal quadrats at Greencastle (all locations given in Irish Grid)

	Easting (m)	Northing (m)
Q1 - Greencastle	324760.8	311442.4
Q2 - Greencastle	324758.1	311443.1
Q3 - Greencastle	324739.8	311422.6
Q4 - Greencastle	324739.4	311420.7
Greenore Top	322444.0	311114.0
Greenore Bottom	322452.0	311129.0

Figure 7.2: Aerial View Showing Locations of Intertidal Quadrat Sampling Positions

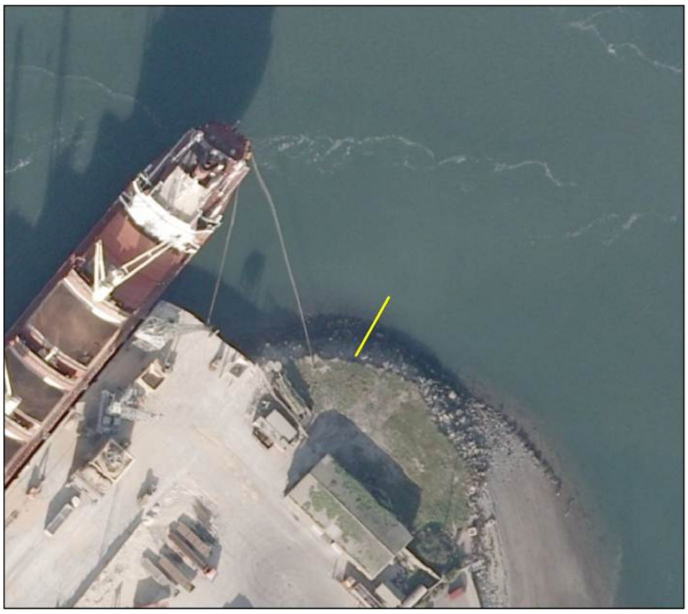


Figure 7.3: Aerial View Showing Location of Intertidal Transect at Greenore

7.1.4 Intertidal Soft Benthos Survey

Fieldwork was carried out on the 11th / 12th April, 2012. All sampling stations were positioned using a handheld GPS (Trimble Geo-XM - Intertidal 7-15 or Garmin 72H – Intertidal 1-6). A list of the stations sampled are presented in Table 7.2 and these stations are displayed on a map (Figure 7.4 & 7.5)

Table 7.2: Positions of intertidal soft sediment biological sampling stations (All locations are given in Irish Grid)

	Easting (m)	Northing (m)
Intertidal 1	322506	311063
Intertidal 2	322493	311057
Intertidal 3	32487	311057
Intertidal 4	322511	310982
Intertidal 5	322501	310982
Intertidal 6	322491	310981
Intertidal 7	324713.5	311516.2
Intertidal 8	324697.7	311466.0
Intertidal 9	324666.5	311386.5
Intertidal 10	324600.3	311558.2
Intertidal 11	324574.5	311535.3
Intertidal 12	324557.4	311517.1
Intertidal 13	324516.8	311626.8
Intertidal 14	324503.4	311604.1
Intertidal 15	324485.5	311587.6

Figure 7.4: Aerial View Showing Locations of Intertidal Soft Sediment Sampling Positions at Greenore

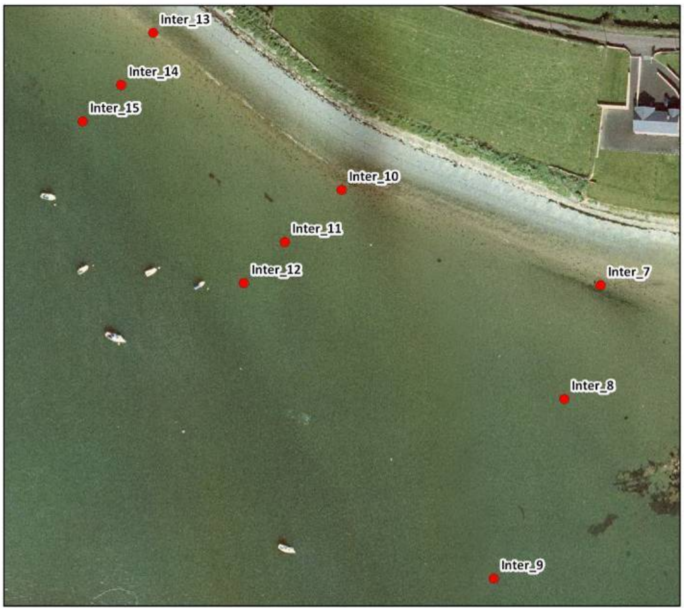


Figure 7.5: Aerial View Showing Locations of Intertidal Soft Sediment Sampling Positions at Greencastle

7.1.4.1 Intertidal Core Sampling

Six cores were sampled on the Greenore side by means of a $0.25m^2$ dig through as the sediment there consisted entirely of gravels and coring was not possible. Samples were examined by eye, on site and any fauna observed were collected.

The main substrate along the Greencastle shore consisted of sands and were therefore collected using the standard methods prescribed by JNCC for the identification of habitats, as follows at each site:

- 5 x Replicate 11.1cm Ø cores (Area = 0.01m2) were taken to a depth of 20cm at each shore height. Each core was placed in a plastic bag with 2 waterproof labels. The cores were then

puddle sieved on site through a 1mm sieve. The sample retained on the sieve was then carefully washed into a plastic bag and preserved in a 10% formaldehyde-seawater solution and sealed for transfer back to the laboratory.
- Where applicable, 1 x 1 meter area of sediment was dug out with a hand spade to a depth of 20cm. The removed sediment was then examined on site for macro fauna by sieving through a 5mm sieve.
- A data record sheet was filled out for each sampling station.
- Photographs were taken and recorded using a digital camera.
- A 7cm Ø core was taken to a depth of approximately 5cm for granulometric and Loss on Ignition (LOI) analyses. The contents from each core was then carefully transferred to a pre-labelled plastic zip-lock bag and stored in a cooler box with ice packs for transport back to the laboratory.

7.1.5 Sub-tidal Soft Benthos Survey

7.1.5.1 Subtidal Grab Sampling

All sub-tidal grabs were collected on the 13th April 2012 and were sampled using a 0.1m^2 stainless steel Van-Veen Grab for benthic faunal analysis. All sampling stations were positioned using a GPS (Trimble Geo-XM). A list of the stations sampled are presented in Table 7.3 and these stations are displayed on a map (Figure 7.6)

Table 7.3: Positions of sub-tidal soft sediment sampling stations (All locations are given in Irish Grid)

Station	Co-ordinates (Irish Grid)	
	Easting (m)	Northing (m)
	Subtidal Grabs	
Grab 1	324527.8	311505.8
Grab 2	324460.3	311509.0
Grab 3	324498.2	311506.2
Grab 4	324586.1	311428.7
Grab 5	324444.0	311559.9
Grab 6	324425.2	311489.7

Figure 7.6: Aerial View Showing Locations of Sub-Tidal Soft Sediment Sampling Positions

At each station:

- 1 x $0.1m^2$ Van-Veen grab taken for benthic faunal analysis.
- 1 x $0.1m^2$ Van-Veen grab from which a small amount of sediment was retained for Particle Size Analysis and Loss on Ignition Analysis.

7.1.5.2 Subtidal Anchor Dredge Sampling

The benthos adjacent to the shore at Greenore consists of coarse gravels and cobbles, so grab sampling was not possible. As such, ASU used a modified anchor dredge to collect benthic samples in the area. Samples were collected on 13th April, 2012. A list of the stations sampled are presented in Table 7.4 and displayed on a map (Figure 7.7).

Table 7.4: Positions of sub-tidal Anchor Dredge sampling stations (All locations given in Irish Grid)

	Co-ordinates (Irish Grid)				
Station	**Northing**	**Easting**	**Site**	**Northing**	**Easting**
AD1 (in)	311063.8	322527.0	AD4 (in)	310979.8	322548.0
AD1 (out)	311121.2	322481.8	AD4 (out)	311075.3	322530.3
AD2 (in)	311080.9	322538.9	AD5 (in)	310924.7	322555.0
AD2 (out)	311131.7	322507.4	AD5 (out)	311005.2	322542.5
AD3 (in)	311088.8	322543.5	AD6 (in)	311112.3	322514.8
AD3 (out)	311144.8	322468.1	AD6 (out)	311147.9	322440.3

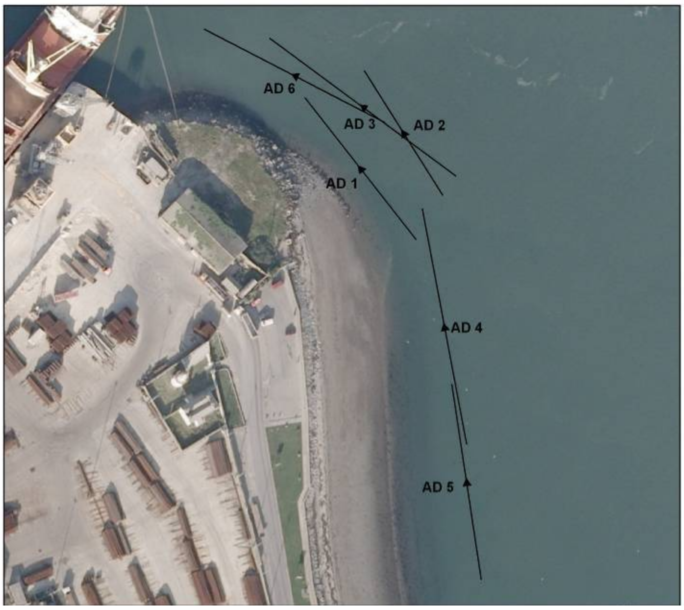


Figure 7.7: Aerial View Showing Locations of Sub-Tidal Dredge Sampling Positions

A total of 6 stations were sampled along the sub-tidal shoreline of Greenore. At each station:

- The anchor dredge was deployed 20 m in advance of the target and sufficient warp was paid out. The dredge was then towed for two minutes to allow for a suitable sample volume to be collected. The retained sample was transferred to a labelled container.

7.1.5.3 Subtidal Video Survey

Fieldwork was carried out on the 13th April, 2012. All sampling stations were positioned using a GPS (Trimble Geo-XM). A list of the stations sampled are presented in Tables 7.5 and these stations are displayed on maps (Figure 7.8 and 7.9)

Table 7.5: Positions of sub-tidal video survey stations (All locations are given in Irish Grid)

Station	Co-ordinates (Irish Grid) Northing (m)	Easting (m)	Station	Co-ordinates (Irish Grid) Northing (m)	Easting (m)
	Video Locations			**Video Locations**	
Video_1	311083.9	322518.8	Video_10	310944.9	322575.0
Video_2	311130.7	322486.4	Video_11	311457.2	324576.0
Video_3	311149.0	322463.7	Video_12	311432.1	324630.2
Video_4	311123.8	322474.2	Video_13	311424.9	324591.5
Video_5	311102.1	322545.7	Video_14	311527.1	324537.7
Video_6	311097.9	322542.7	Video_15	311497.9	324467.1
Video_7	311035.2	322560.2	Video_16	311586.3	324475.3
Video_8	311043.6	322536.2	Video_17	311549.0	324453.1
Video_9	310932.5	322540.7	Video_18	311517.9	324407.8

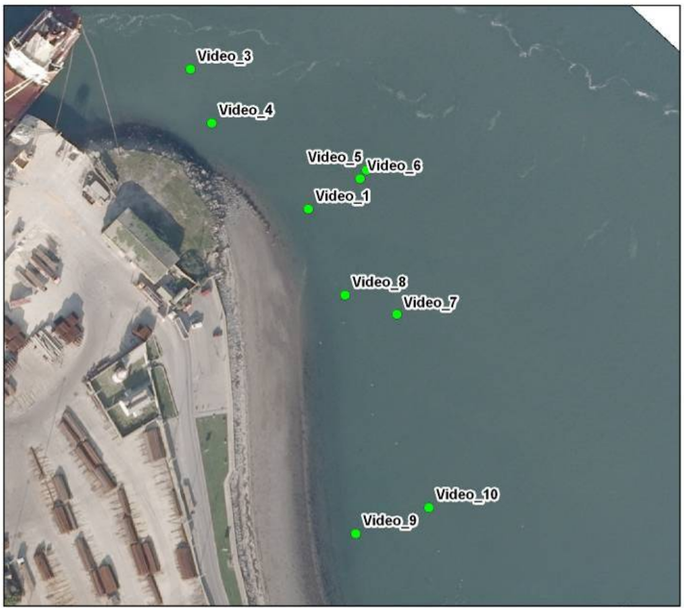


Figure 7.8: Aerial View Showing Locations of Sub-Tidal Video Sampling Positions at Greenore

Figure 7.9: Aerial View Showing Locations of Sub-Tidal Video Sampling Positions at Greencastle

A total of 18 stations were sampled using a drop down video camera system. Data was recorded as MPEG4 format files, recorded directly to a portable DV recorder.

At each station:

- A single recording was taken at each location. The video camera was lowered to above the sediment surface, and video imagery was recorded onto a portable DV recorder in mpeg4 format.

7.1.6 Sample Processing

7.1.6.1 Granulometric Analysis

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The brass sieves chosen were 4mm, 2mm, 1mm, 500µm, 250µm, 125µm and 63µm. The sediments were then divided into three fractions: % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm). Further analysis of the sediment data was undertaken using the Gradistat package (Blott & Pye, 2001[1]).

7.1.6.2 Organic Matter Analysis

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450˚C for 6 hours and organic carbon was calculated as % sediment weight loss.

7.1.7 Biological sample processing

On returning to the laboratory all faunal samples were sieved on a 1mm mesh sieve within 24 hours of collection. Samples were preserved in 4% buffered formalin to which an organic dye (Rose-Bengal) had been added. All fauna were identified to the lowest taxonomic level possible using standard keys to north-west European fauna.

[1] Blott SJ and K Pye, 2001, GRADISTAT, Earth Surf Proc and Landforms 26: 1237-1248

7.1.8 Inter-Tidal Hard-Benthos Survey Results

7.1.8.1 Greencastle Shore

The proposed slipway installation on the Greencastle shore will be situated mid way between the existing wooden-piling pier ~180m to the west (Plate 7.1) and an isolated intertidal rock ~220m to the east (Plate 7.1). It will be an open structure carried on steel tubular piles comprising a 15m wide slipway or ramp for embarking and disembarking vehicles and an adjoining 4m wide higher structure with buffers to berth the ferry alongside the on-off ramp. The intertidal area traversed by the new installation comprises shingle in the upper shore (Plate 7.1) and in the mid and lower shore fine and medium sands (Plate 7.1). The upper shingle has a band of drift seaweed (2-2.5m wide) and above this in the terrestrial zone a rough grassy margin with Sea beet, Mallow, various compositae and some maritime and other grass species backed by agricultural grassland (Plate 7.1). The shingle / cobble extends as far west as the existing pier and about 100m to the east beyond which the upper shore becomes more sand dominated (Plate 7.2).

Rocky Outcrop – East of Proposed Berthing Installation

The low moulded rocky outcrop to the east (Plate 7.2) is wholly within the intertidal and is a typical fucoid and barnacle dominated habitat of moderately exposed coasts with evidence of sand-scour in places. The dominant brown macroalgae were *Fucus vesiculosus* and *F. serratus* with a little *Ascophyllum nodosum* also. Small amounts of *Chondrus crispus*, *Gelidium* sp. and sand-binding reds (*Rhodothamniella floridula*) were also present. In the lower rock faces immediately above the surrounding sand the rock surface was often covered with a layer of sand with interspersed encrusting calcareous red algae in places with numerous tiny seed mussels (*Mytilus*).(Plate 7.2) Heavily scoured *Sabellaria* colonies were also evident in these situations also (Plate 7.2). Other fauna included littorinid snails, dog whelks (*Nucella lapilus*) including juveniles and eggs, barnacles (*Chthamalus* spp. *Elminius modestus*, *Semibalanus balanoides* and *Verruca stroemia*). Other species included the starfish *Asterias rubens* as well as scattered small patches of the sponges *Halichondria panicea* and *Hymeniacidon perleve.* Overall, the fauna and seaweeds were typical for such areas and with a moderate to strong sand scour influence.

Wooden Pier

The existing wooden pier structure is surrounded by sand for the most part (Plate 7.3) while in the very low intertidal it is strengthened by concrete filled bags and steel struts (Plate 7.3). The pile structure forms a attachment point for scattered browns seaweeds (fucoids), *Enteromorpha* (locally common), *Ulva, Gelidium, Rhodothamniella*, and other reds including *Membranoptera alata* (frequent), *Chondrus crispus* (common), *Lomentaria articulata* (frequent) and *Plumaria plumose* (occasional) toward the very lower tidal area of the structure. Barnacles are in generally low cover values but locally denser (Plate 7.3) especially toward the lower (seaward) end where *Balanus crenatus* is present. At the time common starfish were frequent in the lower intertidal part of the structure while other species such as beadlet anenomes (*Actinia equina*) and littorinid snails were occasionally observed also. The sponges *Halichondria* and *Hymeniacidon* sponge were also noted.

Rocky Outcrop – West of the Wooden Pier

About 170m farther west of the existing pier, there is another rocky outcrop in the intertidal. This is dominated by brown seaweeds and barnacles (Plate 7.3). *Fucus serratus* dominates the seaward part of the outcrop while, *Ascophyllum* with *Polysiphonia lanosa* and *F. vesiculosus* are common elsewhere. Other seaweed species included small amounts of *Cladophora rupestris*, *Ulva lactuca*, *Osmunda pinnatifida*, *Chondrus crispus* and encrusting calcareous red alga. Large parts of the outcrop were dominated by barnacles (*S. balanoides* and *Chthamalus* sp.) with scattered limpets (*Patella vulgata*), while Dog whelks (*Nucella lapilus*) including juveniles, the winkle *Littorina obtusata*/*mariae* and beadlet anemone (*Actinia equina*) were frequently encountered also.

Habitat Classification

Using the JNCC Marine Habitat Classification system, the Greencastle intertidal rock habitats are dominated by the habitat type LR.MLR.BF.FvesB (*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock) merging into LR.MLR.BF.Fser (*Fucus serratus* on moderately exposed lower eulittoral rock), the latter with a sand scour influence. The habitats and range of species encountered on the hard intertidal surfaces within the Greencastle area surveyed are typical for the latitude, substrates, exposure regime and salinity range at the site.

Plate 7.1: 1 = view west from site toward Greencastle Pier, 2 = view from site toward low intertidal rock outcrop (2 hrs after HT), 3 = single in upper shore at the site, 4 = medium sand shore in mid and low shore looking from Greencastle Pier toward the site.

Plate 7.2 : 5 = sandy upper shore about 200m east from the site, 6 = intertidal rocky outcrop 120m east of the site (view from seaward side toward the shore). 7 close up of lower shore rock surface with mosaic of encrusting calcareous red algae, sand and tiny mussels, 8 heavily scoured *Sabellaria* on lower shore rock surface.

Plate 7.3 : 9 = Greencastle Pier, view toward shore; 10 = Greencastle Pier, seward end showing various supports; 11 close up of barnacles (*Elminius modestus*) on wooden pilings of the pier; 12 rocky intertidal outcrop west from Greencastle Pier.

Greenore Shore

The intertidal area adjoining the proposed slipway at Greenore Point comprises two main types. To the north toward the tip of Greenore Point, the shore is mainly constructed of large rock armour elements which extend all around to a slipway at the point (Plate 7.4), whereas south of the proposed installation along the shore toward Ballagan Point the shore is predominantly sedimentary (Plate 7.4). Within the footprint of the new slipway and berthing pylons the habitat comprises a mix of these two elements. Along the entire southern shore the unstable nature of medium/coarse sand and shingle substrate prevents the development of any algae or attached fauna over virtually the entire area. At low spring tides there were some fine red algae noted among the shingle cobble elements at the very edge of the water line in places along the southern shore. The footprint of the development is over barren rock armour in the supra-littoral and upper shore (Plate 7.4), shingle and sand in the mid shore and sandy shingle with a line of large sandstone boulders at or immediately above the extreme low tide mark (Plate 7.5).

In the absence of surface dwelling flora or fauna in the immediate area of the development the rock armour embankment protecting the very tip of Greenore Point was examined for its dominant intertidal communities and species including a transect survey about 40-50m along the shore NW from the proposed facility. The shore here is steep and the substrate comprised entirely of large angular boulders.

The transect ran about 19m from the top of the shore to the end of the *Fucus serratus* zone just above low water spring tide (Plate 7.5). The top of the shore at 0m was on bare rock armour, with the top of the *Enteromorpha* ‘zone’ at 5.8m down the transect, top of *Fucus spiralis* zone at 6.8m, top of *F. vesiculosus* at 8.6m and top of *F. serratus* at 13.3m ~19m top of *Laminaria* (Plate 7.5)

The shore is typified by an upper shore zone of *Enteromorpha* followed by a typical moderately exposed rocky intertidal zonation of fucoid (brown) seaweeds down the shore with little in the way of habitat diversity e.g. crevices rock pools or overhangs. For that reason encrusting organisms, particularly barnacles (in this case *Elminius modestus, Semibalanus balanoides* and *B. crenatus*) and those that can attach tightly e.g. limpets, dominate the faunal element of the community. Toward the lower part of the transect, diversity increases with the encrusting species also including, tube worms *Pomatocerous* and *Spirorbis* along with the barnacle *Balanus crenatus* occurring commonly on boulders (Plate 7.5). There are small patches of highly eroded *Sabellaria* tubes another polychaete worm, which in this case has a sandy tube. Other species encountered included dog whelks (*Nucella lapilus*), the common tortoise shell limpet (*Testudinalia testudinalis*) and a starfish (*Henricia* sp.) (Plate 7.5).

7.1.8.2 Habitat Classification

Using the JNCC Marine Habitat Classification system, the Greenore intertidal rock habitats are dominated by the habitat type LR.MLR.BF.FvesB (*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock) merging into LR.MLR.BF.Fser (*Fucus serratus* on moderately exposed lower eulittoral rock). The sedimentary habitats are classified elsewhere in this report. The habitats and range of species encountered on the hard intertidal surfaces at Greenore are typical for the latitude, substrates, exposure regime and salinity range at the site.

Plate 7.4: 13 = Rock armour above shore close to proposed berth; 14= Rock armour and steel palisade fencing at Greenore Point headland (HT+2hr); 15 = sand and shingle shore south of pier site (view north toward proposed ferry berth), 16 = lower shore at low spring tide (7-3-12) showing gravelly sand shore with line of boulders just at the site of the proposed berth.

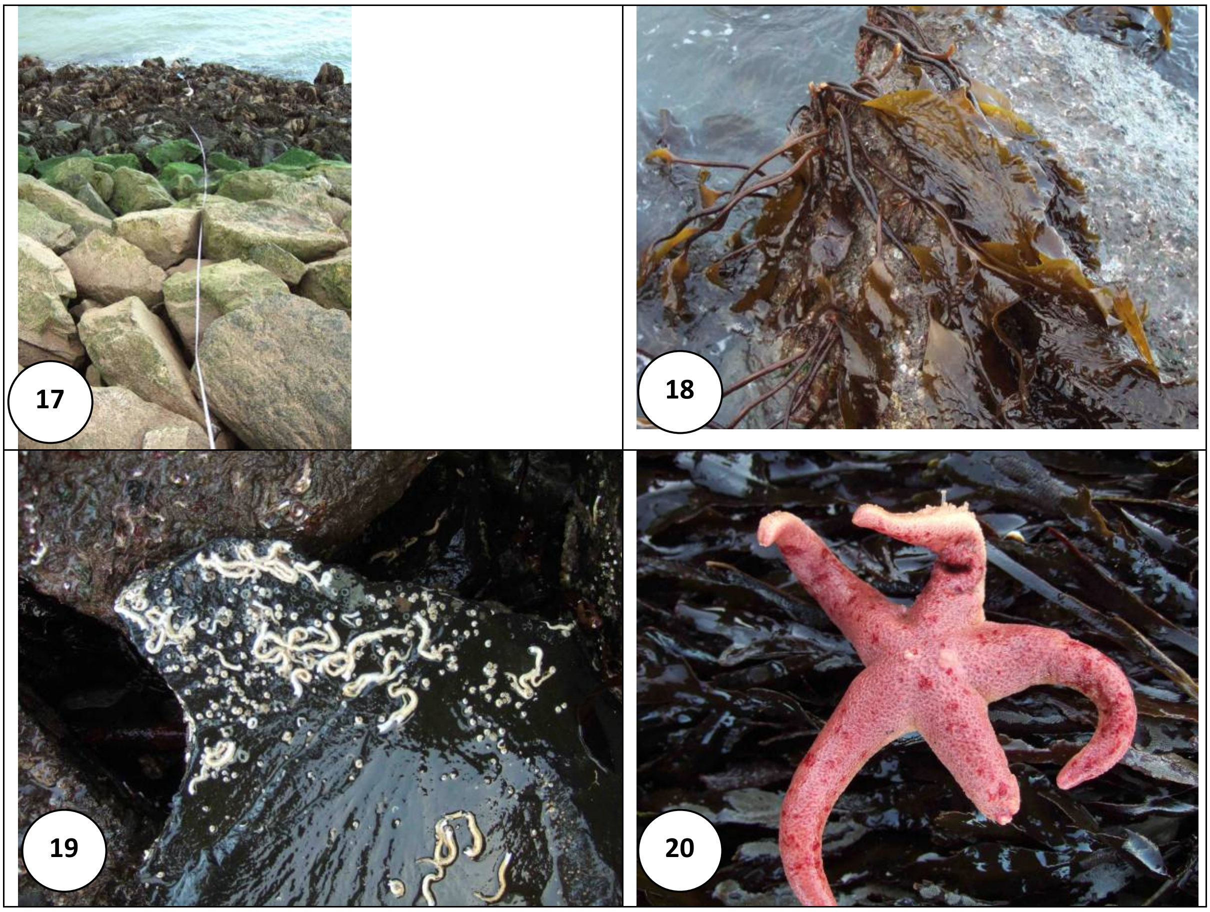


Plate 7.5: 17 = line of transect at Greenore Head; 18 = *Laminaria* at LW spring tide; 19 = encrusting species (*Spirorbis*, *Pomatoceros* and *Sabellaria*) in the lower intertidal; 20 = the starfish *Henricia* sp. on bryozoan- covered *Fucus serratus* fronds.

7.1.9 Intertidal Soft-Benthos Survey Results

7.1.9.1 Physical Data

Results from the sediment analysis (Table 7.6 and Figure 7.10) highlight the varying nature between the intertidal areas at Greenore and Greencastle. The intertidal present at Greenore are dominated by gravels across the length of the shore line (Intertidal 1-6). The intertidal present along the intertidal shoreline at Greencastle is dominated by fine sands (Intertidal 7-15). Loss on Ignition values are low across the area, which is typical for sandy and gravelly sites.

Table 7.6: Sediment Characteristics for Intertidal Samples

Site	% Gravel	% Sand	% Mud	Textural Classification	% LOI
Intertidal 1	78.7%	20.5%	0.8%	Sandy Fine Gravel	0.70%
Intertidal 2	99.6%	0.3%	0.1%	Fine Gravel	0.57%
Intertidal 3	77.1%	22.7%	0.3%	Sandy Fine Gravel	0.78%
Intertidal 4	67.1%	32.5%	0.4%	Sandy Fine Gravel	0.63%
Intertidal 5	100.0%	0.0%	0.0%	Gravel (visual inspection only)	n/r
Intertidal 6	100.0%	0.0%	0.0%	Gravel (visual inspection only)	n/r
Intertidal 7	0.5%	98.1%	1.4%	Slightly Very Fine Gravelly Medium Sand	0.50%
Intertidal 8	0.0%	98.8%	1.2%	Well Sorted Medium Sand	0.70%
Intertidal 9	0.0%	98.4%	1.6%	Moderately Well Sorted Medium Sand	0.66%
Intertidal 10	4.1%	95.1%	0.8%	Slightly Very Fine Gravelly Medium Sand	0.51%

Site	% Gravel	% Sand	% Mud	Textural Classification	% LOI
Intertidal 11	0.0%	99.3%	0.7%	Well Sorted Medium Sand	0.63%
Intertidal 12	0.0%	98.6%	1.4%	Moderately Well Sorted Medium Sand	0.60%
Intertidal 13	2.5%	96.9%	0.7%	Slightly Very Fine Gravelly Medium Sand	0.50%
Intertidal 14	0.0%	99.6%	0.4%	Well Sorted Medium Sand	0.55%
Intertidal 15	1.2%	95.5%	3.3%	Slightly Fine Gravelly Medium Sand	0.70%

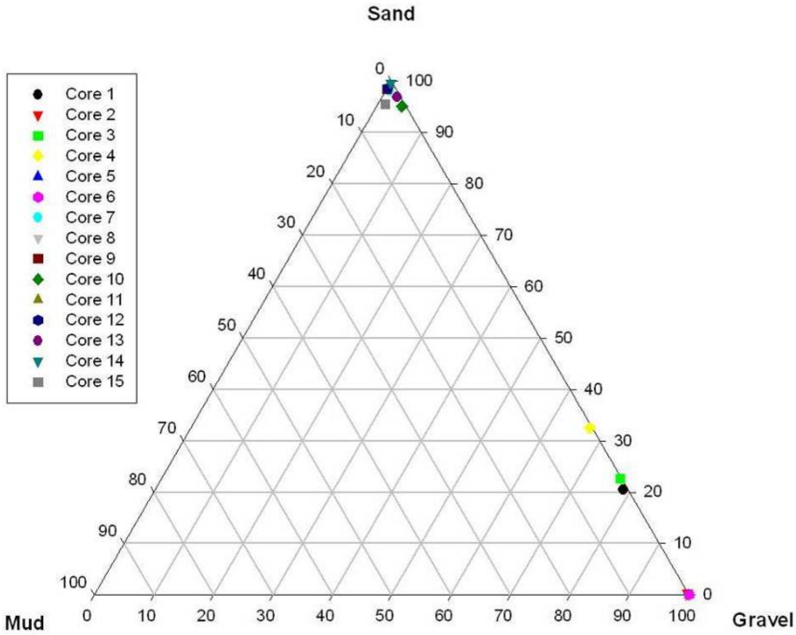


Figure 7.10: Ternary Plot of Particle Size Analysis at Each of the Intertidal Sampling Locations

7.1.9.2 Biological Data

Greenore

The soft sediment intertidal area at Greenore is dominated by coarse gravels with a very low sand content (Plate 7.6). This is reflected in the very low diversity of infauna identified at the site. Only a single species, *Orbinia* sp. was identified across the area, and this was present in only 2 locations (Intertidal 1 & 2). No infauna was identified in 4 of the Greenore intertidal stations (Appendix 7.2a).

Only a single habitat type was identified along the gravel shoreline of Greenore. This area has been classified as LS.LCS.Sh Shingle (Pebble) and Gravel Shores. This biotope has been described as '*Littoral shingle and gravel shores include shores of mobile pebbles and gravel, sometimes with varying amounts of coarse sand. The sediment is highly mobile and subject to high degrees of drying between tides. As a result, few species are able to survive in this environment.*' This reflects the very low species diversity present on this stretch of shoreline to the south of the proposed landfall area at Greenore.

Greencastle

A total of 23 taxa were encountered in the intertidal core samples (Appendix 7.2b) from Greencastle. The fauna identified in the cores at Greencastle are typical of fine sand communities, dominated by the polychaetes *Nephtys cirrosa* and *Scolelepis squamata* as well as the bivalve mollusc *Angulus tenuis*. A full list of species and their diversities are presented in Appendix 7.2.

The fauna present in the area of the proposed landfall at Greencastle are typical of moderately exposed fine sand shores. In addition, variation in biotope based on tidal heights was present in the area. The upper shore consisted primarily of LS.LSa.MoSa.AmSco - Amphipods and *Scolelepis* spp. in littoral medium-fine sand. This biotope has been described as '*Mobile clean sandy beaches on exposed and moderately exposed shores, with sediment grain sizes ranging from medium to fine, often with a fraction of coarser sediment. The sediment contains little or no organic matter, and usually no anoxic layer is present at all. It tends to be well-drained, retaining little water at low tide. These beaches usually occur under fully marine conditions. The mobility of the sediment leads to a species-poor community, dominated by polychaetes, isopods and burrowing amphipods.*'

The mid- and low-shore areas of the survey area are dominated by the fine sand dominated community LS.LSa.FiSa.Po – Polychaetes in littoral fine sand. This area is described as *'Moderately exposed or sheltered beaches of medium and fine, usually clean, sand, though the sediment may on rare occasions contain a small silt and clay fraction. The sediment is relatively stable, remains damp throughout the tidal cycle, and contains little organic matter. It is often rippled and typically lacks an anoxic sub-surface layer. Where an anoxic layer is present, it occurs at a depth below 10 cm and tends to be patchy. The biotope occurs mainly on the lower part of the shore, and relatively frequently on the mid shore. It is only rarely present above mid shore level, except where coastal defences cause backwash onto the upper shore. Conditions are usually fully marine, though the biotope can also occur in open lower estuarine conditions.'* Two sub-biotopes have been identified in the area, LS.LSa.FiSa.Po.Aten – Polychaetes and *Angulus tenuis* in littoral fine sand and LS.LSa.FiSa.Po.Ncir – *Nephtys cirrosa*-dominated littoral fine sand which are present across the mid and low shore of the survey area.

Plate 7.6: 1 = view north from shingle beach to Rock Armour at Greenore, 2 = view up shore of the shingle beach at Greenore, 3 = Shingle Beach, 4 = View south along the shingle shoreline at Greenore

Plate 7.7: 5 = view up shore from Intertidal 7 location indicating the shingle top shore at Greencastle, 6 = Sediment surface at Intertidal site 8, 7 = View along the low shore towards the wooden pier at Greencastle, 8 = View of anchorage at Greencastle, 9 View east along the top shore, showing mobile sand adjacent to shingle top shore.

7.1.10 Sub-Tidal Video Survey Results

A total of 18 video grabs were taken in the immediate sub-tidal area of the landfall locations at Greenore (10 drop sites) and Greencastle (8 drop sites). A detailed overview on each video drop is presented in Appendix 7.4 along with frame grabs from each (Plates 4.1-4.7)

7.1.10.1 Greenore

The habitats identified in the video survey of Greenore indicate the presence of strong hydrodynamic currents in the area. The area in the vicinity of Greenore Point (Video drops 1-8) consists primarily of tide swept cobbles and pebbles, dominated by the keelworm *Pomatoceros* sp. and balanomorph barnacles. The benthos becomes more stable to the south of Greenore Point (Video Site 9 & 10), with an increase in faunal diversity and the development of a mixed community of *Ophiocomina nigra* and *Ophiothrix fragilis*.

7.1.10.2 Greencastle

The habitats identified in the video survey of Greencastle show the presence of a single habitat type, Infralittoral fine sands (SS.SSa.IFiSa), which is an extension of the intertidal habitat of LS.LSa.FiSa.Po (Polychaetes in littoral fine sands). Taxa identified at Greencastle include the ascidian *Ascidiella aspersa* in addition to fine reds and occasional *Laminaria saccharina* present on the sediment.

7.1.11 Sub-Tidal Benthos Survey Results

7.1.11.1 Physical Data

Only particle size analysis was undertaken on the sediment collected from the Greencastle area of the survey area. The coarse nature of the sediment at Greenore, and subsequent nature of the sampling, did not allow for the collection of sediment for Particle Size Analysis (PSA) or Loss on Ignition (LOI) analysis.

Results from the sediment analysis (Table 7.7 and Figure 7.11) indicate the Greencastle survey area is dominated by medium sands. LOI values are in keeping with the sandy nature of the sediment with all sites returning relatively low LOI results (Table 7.7).

Table 7.7: Sediment Characteristics for Subtidal Grab Samples Collected At Greencastle

Site	% Gravel	% Sand	% Mud	Textural Classification	% LOI
Grab 1	0.0%	99.0%	1.0%	Moderately Well Sorted Medium Sand	0.54%
Grab 2	2.3%	96.2%	1.6%	Moderately Sorted Slightly Gravelly Sand	0.83%
Grab 3	0.0%	97.8%	2.2%	Moderately Well Sorted Medium Sand	0.75%
Grab 4	0.0%	99.7%	0.3%	Moderately Well Sorted Medium Sand	0.35%
Grab 5	0.0%	98.8%	1.2%	Well Sorted Medium Sand	0.64%
Grab 6	84.3%	15.1%	0.7%	Fine Gravel	n/r

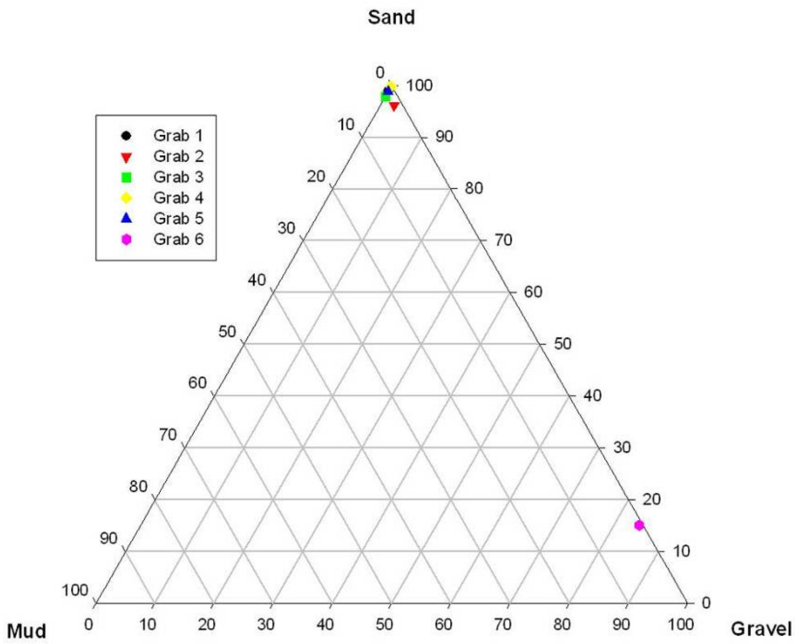


Figure 7.11: Ternary Plot of Particle Size Analysis at Each of the Sub-Tidal Sampling Locations at Greencastle

7.1.11.2 Biological Data

Greenore

A total of 75 taxa were encountered in the sub-tidal dredge samples taken in the sub-tidal area near Greenore- Appendix 7.3a. The most dominant species identified in the dredge samples are the polychaete worms, *Pomatoceros lamarcki, Odontosyllis ctenostoma* and juvenile crustaceans *Balanamorpha* spp (acorn barnacles). These species are typical of coarse benthos and highlight the exposed nature of the site to strong tidal currents. The results obtained in the dredge survey indicate the presence of the same habitats identified in the video survey.

Dredges 1-3 all confirm the presence of the SS.SCS.CCS.PomB (*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles) biotope across these areas.

Dredges 4-6 record the presence of increased numbers of the brittlestars *Ophiocomina nigra* and *Ophiothrix fragilis*. This indicates the presence of the SS.SMx.CMx.OphMx - *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment as identified in Video Drop 10 (Plate 4.4, Appendix 7.4) of the video survey for the area.

Habitat Overview

The habitats identified in the anchor dredge survey correspond with the habitats identified in the video survey. The benthos in the area of Greenore Point consists of a mosaic of SS.SCS.CCS.PomB (*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles) and SS.SMx.CMx.OphMx - *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment. The species and habitats identified at Greenore are common in Irish coastal waters.

Greencastle

A total of 38 taxa were encountered in the sub-tidal grab samples taken at Greencastle - Appendix 7.3b. The sediment present in Greencastle is predominantly sands, and this is reflected in the infaunal species identified in the area. The polychaete worms *Nephtys cirrosa*, as well as the amphipods *Corophium crassicorne* and *Urothoe elegans* reflect the sandy nature of the sediment in the area. A single location contained a large proportion of gravel, and this is reflected in the species composition of the fauna at that site (dominated by the keelworm *Pomatoceros lamarcki*).

The habitats present in the shallow subtidal in the vicinity of the landfall location at Greencastle consist primarily of Infralittoral Fine Sands (SS.SSa.IFiSa). Occasional patches of sandy gravel are present in the area (as indicated by the presence of the gravelly site - Grab 6) indicating the area is subjected to strong hydrodynamic influences on occasion.

Habitat Overview
The habitats identified in the grab survey correspond with the habitats identified in the video survey. The benthos in the area of Greencastle consist primarily of Infralittoral fine sands (SS.SSa.IFiSa). The species and habitats identified at Greenore are common in Irish coastal waters.

7.1.12 Habitats of Conservation Interest

7.1.12.1.1 Greencastle

The Carlingford Lough ASSI is known to contain a range of unusual and rich littoral communities as follows:

(i) Dense intertidal communities of the sea potato *Echinocardium cordatum* – in the lower beach at Cranfield Point,
(ii) A unique community association for Northern Ireland of a boulder based fucoid community superimposed on a wide mud and sand dominated intertidal flat (covering large areas of Mill Bay)
(iii) Large areas of saltmarsh (in Mill Bay)
(iv) A sheltered boulder shore rich in invertebrates (near Killowen Point)
(v) Three out of four major intertidal sedimentary communities found in Northern Ireland are present in Mill Bay.

Of the above, only sedimentary communities were present within the footprint of the development or within the adjacent area in which the coastal processes model indicated that there would be any localised alterations to current velocities. Potential impacts on this latter habitat, which would fall under the Annex I of the Habitats Directive as *1140: Mudflats and Sandflats not covered by seawater at low tide* is dealt with in the next section (Potential Impacts).

7.1.12.2 Greenore

The proposed landfall at Greenore, Co. Louth is located on the eastern side of Greenore Point, in Co. Louth. This location is within two protected areas – Carlingford Lough pNHA (IE000452) and Carlingford Shore SAC (IE002306).

Several Annex I listed habitats are present along the Carlingford Shore SAC/Carlingford Lough pNHA. These include:

1140: Mudflats and Sandflats not covered by seawater at low tide
1210: Annual vegetation of driftlines
1220: Perennial vegetation of stony banks
1330: Atlantic Salt Meadows.

None of the four Annex I habitats listed above was recorded within or adjacent to the proposed development at Greenore. The short, steep nature of the shore at the site and it’s coarse substrates preclude it’s description as a mudflat or sand flat (Habitat 1140), while the construction of coastal defences in the form of rock armour, low walls and steel palisade fencing (Plate 7.4 – frame 13) has foreshortened the upper-shore / terrestrial zone interface thereby excluding the other 3 habitats listed, which are known from other parts of the SAC.

7.1.12.3 Feeding for Pale-bellied Brent Geese within the Intertidal Survey Areas

Pale-bellied Brent Geese *Branta bernicla hrota* are known to feed on *Zostera* beds and the green alga *Enteromorpha* in the intertidal and the occurrence of these plants within the study areas was considered. *Zostera* was not recorded during surveys of Greenore or Greencastle while *Enteromorpha* (now classified as *Ulva*) was recorded at both sites. On the Greencastle shore, locally common amounts were noted on the existing wooden pier structure and while not specifically recorded at the two rocky outcrops to the east and west of the proposed pier, it may occur in small amounts at these locations also, from time to time. On the Greenore side, extensive cover of *Enteromorpha* was noted on steep rock armour in the mid to upper shore NNW of the proposed pier where it formed a very thin cover (Plate 7.4 – frame 14; Plate 7.5 – frame 17).

7.1.13 Impact Assessment

7.1.13.1 Potential Impacts

Overview

The potential impacts to the marine ecology of the study area associated with the proposed development will relate to (i) the construction phase and (ii) the operation phase of the development. The construction phase potential impacts relate to (a) habitat loss, (b) temporary habitat disturbance and (c) possible spillages of hydrocarbons and cement as well as the dispersal of suspended solids. Operation phase potential impacts relate to (a) disturbance of benthic habitats by propeller wash, (b) impacts from antifouling coatings on the proposed vessel and (c) fuel spillages during ferry operation.

In-Combination Effects

All potential impacts have been addressed both independently and with regards to any other project or plan listed in Chapter 3 which together may adversely affect marine ecology.

7.1.13.2 Construction Phase Impact

Habitat Loss

The loss of habitat associated with the berthing structures will be extremely small on the Greencastle side given that the proposed berth will be suspended on piles forming an open structure not unlike the existing Greencastle pier in broad design concept. This structure will allow free movement of water and sediment in all directions, with only the combined footprint of the piles constituting the loss of intertidal habitat. On the Greenore side while the structure will be significantly constructed between sheet pile walls, the size of the structure (in terms of footprint) is significantly smaller than the Greencastle structure and the habitats over which it is being built are extremely species poor. Taken within the context of the SPAs on both sides of the development, the significance of this amount of habitat loss can be described as negligible.

Temporary Habitat Disturbance

During the construction phase, it is anticipated that heavy construction vehicles will track up and down the intertidal adjacent to both sites in order to build the structures. This will result in the destruction of the burrowing infauna at both sites within the footprint of that disturbance. In the case of both sites this will constitute a negligible impact given the comparatively small areas involved. In both instances, the disturbed areas will begin to recover immediately the disturbance ceases through larval settlement, post-larval displacement (particularly as a result of storms), as well as adult migration from the immediate adjacent intertidal and subtidal area. Full recovery would be expected within 6 months to 2 years. On the Greenore side the particularly unstable and low diversity nature of the impacted habitats will mean that the associate impacts will be even lower than those on the Greencastle shore.

Cement

Given that bulk liquid cement will be used on site (e.g. for in-situ making of the ramp decking) a spillage could result in the death of invertebrates and fish within and adjacent to the spill area with the extent of the impact dependent on the volume of material spilt. While such an impact were it to take place would be short-term it could be very significant. The likelihood of such an incident occurring is considered to be very small provided basic construction site pollution prevention measures are drawn up and implemented.

If the concrete to be used in the casting of the decking is to be batched on site, the batching plant could be the source of cement contaminated run-off which would adversely impact intertidal invertebrates. The extent of such an impact would depend on the volume and strength of the run-off. The likelihood of such impacts occurring is considered low as basic construction site pollution control measures can prevent this occurring.

Oil

Minor oil spills and leaks from construction plant located on or over the intertidal or on jack-up barges can give rise to toxic impacts on invertebrates living within the sediments adjacent to the sites and in the water column. Larger leaks and spills would have adverse impacts on a wide range of marine creatures over a much wider area. Again, basic good practice for the management of construction sites can prevent or minimise such leaks and spills, such that the likelihood of adverse impacts is considered to be low.

7.1.13.3 Operation Phase Impact

Changes in Benthic Habitats Associated with the Proposed Berths

The Coastal Processes Model outlined the changes which would take place in current patterns around the new berthing structures and concluded that '

Assessment of littoral currents under relatively severe events and the presence of the ferry infrastructure show that sediment transport along the shoreline south of Greenore Point would be affected to a greater degree (by ±0.3m/s during ebb tide). This is due to a slight change in the eddy which forms off Greenore Point on the ebb tide. The changes however are mainly localised and as such should not have an adverse impact on sediment transport around the ferry slipways due to the open nature of the proposed structures. It may be concluded that the changes to tidal currents are limited to the immediate vicinity of both developments. The differences indicate that the change in flow regime in the immediate vicinity of the proposed slipways may cause some localised sedimentation.

These findings suggest that the presence of the structures will have very little impact on the sedimentary environment around the Greencastle berth with perhaps a small increase in sedimentation associated with the Greenore berth. The latter is not considered an adverse impact, given that the intertidal in and around the footprint of the development in Greenore are generally very course and species poor, the sedimentation of finer material in this area will only serve to increase the density of infauna present which are currently quite sparse in this area.

Benthic Community Disturbance due to Propeller Wash

The ferry could cause localised resuspension of sediments along its course. This effect would be more likely in shallower water and over finer sediments and therefore more likely to occur along a northern passage route i.e. running to the north of Green Island compared to the southern deeper route. It would be unlikely to occur on the Greenore side of the channel where the substrate is generally courser but might occur on the Greencastle side of the channel where sediments in general are sandier. The significance of such disturbance will depend on the normal levels of disturbance experienced in the area. In general the area can be described as quite dynamic with evidence of sand scour on the Greencastle side where sand substrates are generally very low in fines. This effect is even greater on the Greenore side of the route where the substrates present near the proposed berth are very course. In this situation the communities present can be described as being pre-adapted to wave and current-induced disturbance and consequently less likely to be adversely impacted by disturbance caused by ferry movements. Moreover, the lateral extent of such disturbance at points along the route where it occurred would be expected to be localised because of the high sand content of sediments in general, which would ensure that any resuspended material would settle rapidly after the ferry had past and therefore not give rise to a persistent plume. Therefore, the effect, where it would occur, would be a near-field impact only and have no adverse implications for the protected sites at either side of the channel. The most likely impact in affected locations would be a reduction in the biomass of the benthic infauna in areas experiencing repeated resuspension. The most likely area to experience such an effect would be at the Greencastle berth. Overall this impact is considered minor to negligible, negative and reversible. The coastal processes assessment has indicated that the nature of the vessel is such that prop wash will not occur.

Antifouling Coating

TBT compounds have been banned on large vessels since 2003 and so this antifouling preparation which was extremely toxic to molluscan species, especially dog whelks (*Nucella lapillus*) and oyster larvae, no longer poses a threat in most areas. All antifouling coating are designed to be toxic to the settlement stages of marine invertebrates which could settle on vessel hulls.

The precise anti-fouling coating which will be used on the proposed ferry is not known but is likely to contain a base of cuprous oxide (Cu_2O) plus a range of possible booster biocide such as Sea Nine (DCOIT), dichlofluanid, zineb, zinc pyrithione, copper thiocynate, copper pyrithione etc. Irgarol and Diuron have both been banned from use as anti-fouling biocidal agents on all vessels in the UK due to their persistence and potential impacts in marine environment. The fact that most of these booster biocides have only be used in recent years means that the available literature on their occurrence and fate in the environment is quite limited. However, in comparison to TBT, what is clear is that they tend to be less toxic and to degrade into less toxic components rapidly, often with half-lives of one to a few days depending on the environmental conditions. This means that their presence in the water column at detectable levels (or biologically significant levels) tends to be confined to enclosed marinas where the often high density of craft and poor water movement increase the likelihood of higher concentrations occurring. Unlike TBT their fate in sediments also seems to be shorter lived, although some e.g. dichlofluanid may be more persistent. Elevated levels are most likely in areas where paint chippings from boats are present in the sediment.

Given that the proposed ferry will be operating in an open well mixed waterway, with sediments in the area generally low in fines and therefore with a much reduced capacity to accumulate contaminants, the likelihood of significant adverse impacts arising from the vessel's antifouling coatings or local accumulations in sediments is considered to be negligible. However, this conclusion would not hold if the ferry were being treated on site with antifouling coatings or if old paint was being stripped from it at one of the births as part of the vessels maintenance.

Fuel Spills

If the vessel is being re-fuelled on site, any fuel spillages would potentially have adverse impacts on marine life in the area depending on the volumes relaeased. Even small leaks and spills may have localised affects on the benthos near the berths. The likelihood of theses impacts can be very significantly reduced by proper mitigation such that the likelihood of occurrence is considered very low.

Run-off from hardstand areas used for marshalling cars and HGV's

Surface run-off from carparks at the Greenore and Greencastle sites may be contaminated with suspended solids and small amounts of hydrocarbons and heavy metals. If these drain to the foreshore they may contaminate the local sediments, mainly on the intertidal area close to the berths. This would constitute a minor local impact. Again, this can be minimised by proper mitigation.

7.1.13.4 Impacts on Conservation Site Habitats

None of the Annex I habitats listed as occurring in the Carlingford Shore SAC nor any of the habitats of interest in the Carlingford Lough Area of Special Scientific Interest (ASSI 103) will be significantly adversely impacted by the construction or operation proposed piers or the operation of the proposed ferry route.

7.1.14 Mitigation

Overview

As part of a Construction stage Environmental Management Plan (CEMP), the appointed contractor will be required to draw up a detailed Method Statement outlining how they will construct the proposed slipways in a manner which minimises all possible environmental damage and pollution. The following paragraphs deal with some of the issues which will require to be addressed in the CEMP. ES/EIS Chapter 8 details more mitigation to protect the marine environment.

7.1.14.1 Construction Phase

Habitat Loss

The habitat loss associated with the proposed development is negligible and will be partly offset by the increase in attached fauna and flora on the piled structures of both sets of berths, particularly those toward the middle and lower intertidal end of the new installations. The latter will represent a localised increase in biodiversity at both sites.

Habitat Damage by Construction Traffic

A detailed Method Statement should be drawn up indicating how the construction traffic will be directed and marshalled on site in order to minimise the damage to adjoining intertidal habitats at both sites. Portable fences and or tape should be used to confine traffic to agreed routes and as much as the area over which traffic passes on the intertidal areas should be minimised from the start.

Cement and Oil

If a cement batching plant is required for the project at either site it should be sited as far back from the foreshore as possible on a bunded, hard stand site. Run-off from the batching plant should be prevented from flowing on to the shore without (i) settlement to remove solids and (ii) neutralisation for the balancing of pH to within 6-8 pH.

All cement pouring operations will require to be constantly monitored to ensure that no spills occur. All equipment used in pumping or pouring cement will need to be checked for defects prior to each use in order to prevent spills arising from the failure of poorly maintained or defective equipment.

The security and integrity of all formwork used e.g. for the new deck/platform of the berth will have to be carefully checked in advance of each cement pour to prevent uncured cement spilling into the tide or onto the shore.

All surface runoff from the site compounds will be passed through settlement and hydrocarbon interceptors before it reaches the shore in order to remove suspended solids and hydrocarbons that might be present in the run-off.

All plant will be equipped with drip-trays to prevent oil leaks reaching the shore.

Vehicle re-fuelling will be undertaken within the site compound at least 10m back from the top of the shore.

All fuel stored on site will be held in securely locked and bunded enclosures.

All re-fuelling of plant on the jack-up barge will be undertaken following an agreed protocol designed to minimise the chance of oil spills.

Any fuel stored on the barge will be in a securely locked and bunded enclosure.

7.1.14.2 Operation Phase

Run-off from Vehicle Marshalling Areas

All surface runoff from the vehicle marshalling areas for both births will be directed through grit traps and hydrocarbon interceptors in order to remove solids and oil from the run-off.

Habitat Disturbance due to Propeller Wash

This is not expected to be a significant adverse impact however, choosing as deep a navigation line as possible will help to minimise any disturbance that may occur.

Ferry Refuelling

All hoses and couplings used for re-fuelling the ferry at Greenore and Greencastle will be of suitable recommended specifications in order to avoid hose breakages and spills/leaks through nozzles and couplings. All such equipment will be regularly inspected and maintained to prevent accidental spillages. Fuel storage tanks at Greencastle and Greenore piers will be adequately bunded and tamper-proof locked.

Ferry Maintenance

The ferry should not be maintained at the berths in order to prevent anti-fouling or other chemicals entering the marine environment.

7.2 Marine Mammals

7.2.1 Introduction

This section assesses the potential impacts on marine mammals and recommendations for mitigation measures related to the proposed ferry development at Carlingford Lough in Counties Louth and Down.

Marine mammals are protected by national legislation and by a number of international regulations which the Republic of Ireland and Northern Ireland are signatory to. The main national legislation that affords protection to marine mammals in Irish waters is the Wildlife Act (1976) amendment Act (2000), which prohibits willful interference to wild mammals and disturbance of resting and breeding sites. As Carlingford Lough straddles the border between the Republic of Ireland and Northern Ireland marine mammals in the Lough will also be protected by UK conservation legislation. In Northern Ireland marine mammals are afforded protection in respect of particular methods of killing or taking under The Wildlife & Countryside Act (1981) and the Wildlife (Northern Ireland) Order (1985).

Furthermore, all cetacean (whales, dolphins and porpoises) species occurring in European waters are now afforded protection under the EC Habitats Directive. All cetaceans are included in Annex IV of the Directive as species 'in need of strict protection' Additionally the harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*) are designated Annex II species (those animals of community interest, whose conservation requires the designation of special areas of conservation). Ireland's two pinniped (seals) species the harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) are also designated Annex II species under the EC Habitats Directive requiring the designation of Special Areas of Conservation (SAC), to protect listed species and their habitat.
The Republic of Ireland and the UK are also signatory to conservation orientated agreements under the Bonn Convention on Migratory Species (1983), the OSPAR Convention for the Protection of the Marine Environment of the northeast Atlantic (1992) and the Berne Convention on Conservation of European Wildlife and Natural Habitats (1979).

In light of the legislation and conservation status of marine mammals, careful consideration must be given during all anthropogenic activity with potential effect on the species and their habitat. The National Parks & Wildlife Service (NPWS) of the DoAHG have developed a code of practice for the protection of marine mammals from acoustic disturbance resulting from Acoustic Seafloor surveys (2007). They have also recently produced 'Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters' which pertains to all sources of man-made sound in Irish waters, including coastal development works (NPWS, 2012). Whilst currently in draft format the report describes a process for informed assessment of risk and decision-making with regard to such sources and to outline risk avoidance and/or reduction measures which, in the Department's view, should be considered to minimise the potential effects of sound sources on these animals. Issues of disturbance to marine mammals in general are dealt with via the Wildlife Act licences and Derogations under the Natural Habitats regulations but in some cases where consent is given for an activity by a Regulatory Authority (e.g., coastal dredging or pile driving) the Department as a consultee may recommend MMO monitoring of works and a set of monitoring guidelines.

In UK/Northern Ireland waters there are guidelines by JNCC to minimise disturbance from various anthropogenic sound sources e.g. piling, seismics, explosives and guidelines on The protection of marine European Protected Species from injury and disturbance (JNCC, 2010a-c). In UK waters it is an offence to deliberately capture, kill or injure or to deliberately disturb animals of European Protected Species (including cetaceans and seals). The disturbance offence includes disturbance that could be likely to increase the risk of a negative impact on Favourable Conservation Status.

7.2.2 Methodology

This assessment is based on information on the proposed works which will involve development of shore based facilities on each side of the Lough including concrete slipways and a pier. The report is based on information from published and unpublished literature on marine mammals and communication with local relevant authorities. A site survey and marine mammal surveys were conducted in the Lough by the author and methods and results detailed in section 3.3.

7.2.3 Existing Environment

Based on species' ecology and sighting records the species most likely to use the waters adjacent to Carlingford Lough include the harbour porpoise (*Phocoena phocoena*), harbour seal (*Phoca vitulina vitulina*) and grey seal (*Halichoerus grypus*). There is also a possibility that bottlenose dolphins (*Tursiops truncatus*), Risso's dolphins (*Grampus griseus*), common dolphins (*Delphinus delphis*) and minke whales (*Balaenoptera acutorostrata*) may also pass through the area (Evans, 1992, Berrow *et al*., 2001, 2002; Ingram, 2000; Ingram *et al*., 2001, 2003; Rogan *et al*., 2001; Ó Cadhla *et al*., 2004; Mackey *et al*., 2005).

7.2.3.1 Pinnipeds

Harbour seal

Harbour seals (also known as "common seals") have established themselves at terrestrial colonies (or haul-outs) along all coastlines of Ireland, which they leave when foraging or moving between areas, for example, and to which they return to rest ashore, moult, rear young, engage in social activity, etc. These haul-out groups of harbour seals have tended historically to be found among inshore bays and islands, coves and estuaries (Lockley, 1966; Summers *et al.,* 1980), particularly around the hours of lowest tide. Harbour seals use sites within the Lough for resting, breeding and moulting.

A report by NIEA on seal population trends in Carlingford Lough since 1996 includes the following sources:

- NIEA shore-based surveys (1996 to 2007)
- Loughs Agency-TSR surveys. Boat-based counts undertaken from Loughs Agency and NIEA vessels (2008-2009)
- SMRU aerial surveys for harbour seals – various breeding season and moult counts (2002-2010)

Due to differences in timing and survey methodologies only aerial survey data are presented here to ensure consistency in timing and methodology for reliable comparison of counts and visualisation of trends since 2002 (Figs. 12-13). An aerial census of harbour seals in Carlingford Lough during 2011 recorded a total of 255 harbour seals at haul-out sites (Figs. 15-16) within the Lough (SMRU, unpublished). The sites with highest numbers of harbour seals are Greencastle Point and Green Island (Figs. 15 & 16), up to 150 harbour seals have been observed on Green Island. This is based on aforementioned surveys conducted during moult and breeding season, a site visit (see Section 3) and ancillary data collected during dedicated bird surveys in 2012 (N. Robinson RPS *pers comm*). It is important to note that counts of harbour seals are considered minimum estimates of population only, as a fraction of the population will be at sea and unavailable for counting at the time of the survey, this has been estimated from other studies to be 30-60% during the annual moult (Thompson *et al*., 1997) which is when the majority of surveys were conducted. Counts conducted by the Loughs Agency and Tara Seal Research in 2008 confirmed an abundance estimate (corrected to absolute number) for harbour seal adults/subadults of 350 in August 2008, and a minimum of 54 pups (Burrows, 2011). Pups were sighted on Green Island A and Blockhouse Island/Artillary Fort shore (Fig. 15) (A. Archer DoENI *pers comm*) and by the author at Black Rock (approx 1.2km northwest of Greenore Point).

Harbour seals are most vulnerable to disturbance at their terrestrial haul-out sites during breeding and moulting periods. These events occur between June and September in Ireland. In addition to the identified terrestrial sites, the surrounding waters are likely to be critical habitat for harbour seals, for feeding and/or for navigation to more offshore foraging areas. Results from a study by the author on the haul-out behaviour of harbour seals in southwest Ireland suggests that harbour seals spend up to 80% of their time at sea. Moreover it appears that they are local foragers, over half of the foraging trips were within 5km of the haul-out sites (Cronin, 2007; Cronin *et al*., 2008). Similar behaviour patterns have been seen in studies of harbour seals in Scotland (Thompson & Miller, 1990; R. Sharples, SMRU, *pers comm*). Unlike grey seals harbour seal adults continue to forage during the breeding season (Bonnes *et al.,* 1994). In addition the mating strategy is based on males diving and calling at aquatic display sites (Van Parijs *et al.,* 1997, 2000, Hayes *et al*., 2004). Disturbance from anthropogenic noise during this period could therefore potentially affect mating success.

Grey seal

Grey seals are distributed throughout Irish coastal waters and commonly seen hauled out on more exposed shores than the harbour seal (Kiely, 1998). Harbour seal records account for the vast majority of sightings within Carlingford Lough and grey seals are very much in the minority (Burrows 2011).The nearest significant breeding sites on a national scale to Carlingford Lough are St Patrick's Island off Skerries, Lambay, Ireland's Eye, Dalkey Island and the Saltee Islands. All of these sites are also used for moulting, as well as Rockabill. Grey seal counts within the Lough as shown in Fig. 14 are ancillary data gathered during the harbour seal surveys and do not represent accurate population estimates for grey seals, as the accepted time of the year to conduct population surveys for this species is breeding season (Sept-Dec). Therefore the counts for grey seals represent Summer haul-out site use by grey seals within the Lough. A total of 33 grey seals were counted at haul-out sites during an aerial survey in August 2011 (SMRU unpublished). Whilst Carlingford Lough is not a significant breeding or moulting site for grey seals, pups have been sighted e.g. one grey seal pup sighted at Blockhouse Island November 2011 (N. Robinson RPS *pers comm*).

Grey seals are also most vulnerable at their terrestrial haul-out sites during the breeding and moulting periods. These events occur between September and March in Ireland. In addition to the identified terrestrial sites, the surrounding waters are also likely to be a critical habitat for grey seals, for feeding and/or for navigation to more offshore foraging areas. Grey seal have a wider offshore foraging distribution than harbour seals (McConnell *et al.,* 1999) and as a result seals from large breeding colonies on the east coast of Ireland and even larger colonies on the west coast of Scotland may potentially use the waters surrounding in or around Carlingford Lough for foraging and/or navigation.

7.2.3.2 Cetaceans

Harbour Porpoise

Sightings of Europe's smallest cetacean species, the harbour porpoise, have been relatively common off southern coasts of Ireland and in the Irish Sea (Northridge *et al*., 1995; Hammond *et al*., 1995; Pollack *et al*., 1997; O' Cadhla *et al.,* 2004). Reports of harbour porpoises are common on the east coast, particularly around Dublin Bay and Howth Head (Berrow *et al*., 2001; R. Leeney, UCD, *pers. comm*.). Information relating to the movements of this species around coastal areas is very limited but this species is likely to visit Carlingford Lough. Harbour porpoises are very sensitive to vessel noise and activity and are unlikely to approach areas of high activity. The small size of harbour porpoises and their erratic surfacing behaviour make them difficult to detect.

Bottlenose Dolphin

A coastal species of cetacean commonly sighted in western Irish waters (Evans, 1992, Pollock *et al.,* 1997) bottlenose dolphins are numerous on the south and west coasts (Ingram & Rogan, 2003; Ingram *et al*., 2003). The nearest concentration of bottlenose dolphins to Carlingford Lough are a resident community present year-round in the waters of Cardigan Bay in Wales (Arnold, 1993). Although Cardigan Bay is approximately 200km from Carlingford, the bottlenose dolphin is a wide ranging species and individuals commonly travel between coastal regions extensively, especially during the summer months (Ingram *et al*., 2003). A group of up to 20 individuals have been recorded in Carlingford Lough in Summer 2008 and 2009 (IWDG 2012). Bottlenose dolphins may be attracted to vessel activity making them potentially vulnerable to physical harm from industrial activities.

Risso's Dolphin

In Ireland Risso's dophin have generally been recorded close to the coast with highest numbers of sightings between August and February (Pollack *et al*., 1997, 2000). A large and robust species, Risso's dolphins are slow moving and often seen in small schools around the west coast (Berrow *et al.,* 2002). Risso's dolphins will not usually approach vessels but are readily recognised by their distinctive coloration patterns and large size.

7.2.4.4 Common Dolphin

Although a mainly oceanic species, common dolphins have been frequently observed in large schools around the coasts of Ireland (Pollock *et al.,* 1997; Gordon *et al*., 2000) and it is the most commonly stranded cetacean around the Irish coast (Berrow & Rogan, 1997). The mobile schools of common dolphins seen in coastal waters tend to be foraging for shoaling fish species. Common dolphins are attracted to vessels and are easily sighted and identified.

Minke Whale

The most common species of baleen whale found around Irish coasts, the minke whale is frequently recorded off the west coast (Pollock *et al*., 1997, Berrow *et al.,* 2002; O'Cadhla *et al.,* 2004) however sightings in the Irish sea, offshore of Carlingford Lough, have been recorded (Berrow *et al*., 2002; Mackey *et al.,* 2005). Research conducted in UK waters suggest that the species moves southwards to inshore Atlantic Margin waters in spring and summer, remaining until late autumn following which numbers decline (Northridge *et al*., 1995; Pollack *et al.,* 2000).

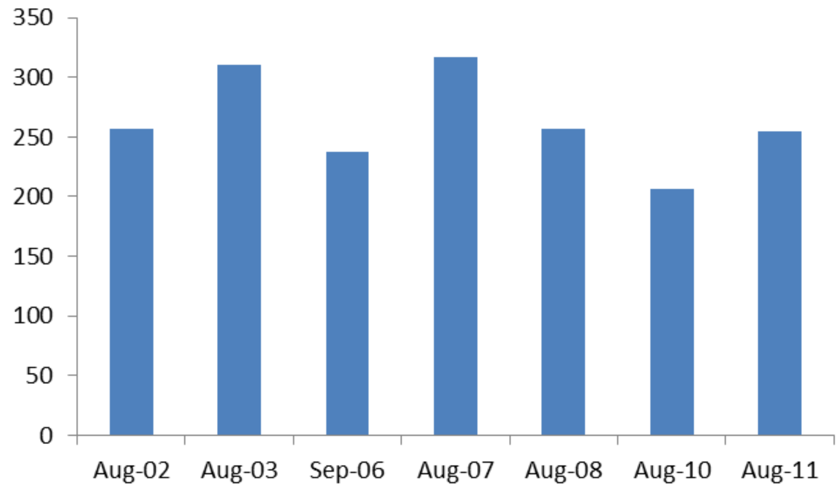


Figure 7.12: Harbour Seal Moult Counts in Carlingford Lough Acquired by Aerial Survey (data from NIEA/SMRU)

Figure 7.13: Harbour Seal Breeding Season Counts in Carlingford Lough Acquired by Aerial Survey (data from NIEA/SMRU)

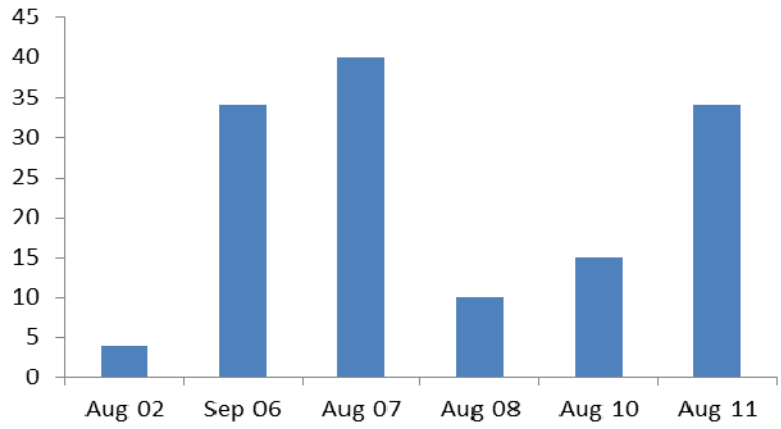


Figure 7.14: Grey Seal Summer Counts in Carlingford Lough Acquired by Aerial Survey (Data from NIEA/SMRU)

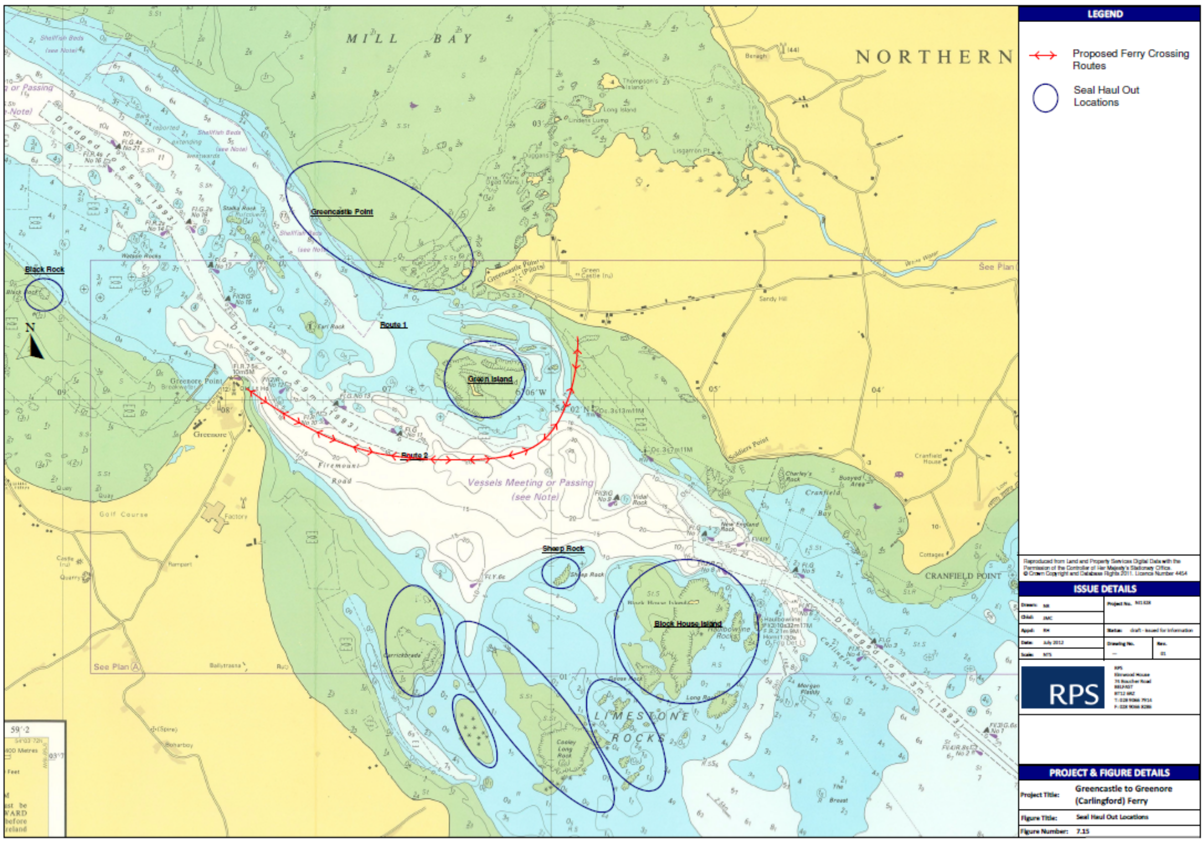


Figure 7.15: Seal Haul-Out Sites in Carlingford Lough Including Proposed Ferry Route to the South of Green Island

Figure 7.16: Seal Haul-Out Sites in Carlingford Lough; Seal Counts from Aerial Survey Conducted in August 2011 (Harbour Seal Moult Counts) (Data Provided By SMRU)

7.2.4 Survey

A visit to Carlingford Lough and adjacent coastal areas was made by the author on June 24th/25th 2012.

7.2.4.1 Methods:

- The waters in the vicinity of Greenore port facilities were surveyed from a vantage point on the south shore of the Lough using a telescope (equipped with a 30x eyepiece) mounted on a tripod and 10 x 50 leica binoculars for all marine mammals at sea on June 24th 2012, between 13.30 and 17.30 (2 hours either side of high tide) (Fig.7.17).

- A survey was conducted on June 25th on a 6.5m Rigid Inflatable Vessel of the shoreline of the area of proposed works and the outer region of the Lough, the islands, skerries and intertidal areas including Greencastle Point, Green Island, Sheep Rock, Blockhouse Island, Cooley Long Rock and Haulbowline Rocks and Black Rock. These areas were surveyed using 10 x 50 leica binoculars for all seals ashore during the low water period between 10.15 and 12.00 (low water + 2 hours). The low water period was surveyed in order to maximise the likelihood of observing seals hauled out on rocks.

Observations of marine mammals at sea are affected by prevailing sea conditions with a decline in sighting probability in Beaufort sea-states of three or higher. The conditions on June 24th/25th were favourable for visual surveillance, with a Beaufort sea-state of one and a very light variable breeze.

7.2.4.2 Results:

- No cetaceans were observed during visual observations, but given the limited time available and the transient nature of cetacean movement patterns this does not indicate that the area is not visited by dolphins or porpoises.
- A total of **134 Harbour seals** were counted (ashore or in water in vicinity of haul-out site) on June 25th including 131 adults/juveniles and **3 pups** (Figs. 7.18 & 7.19)
- A total of **44 Grey seals** were counted (ashore or in water in vicinity of haul-out site) on June 25th, mostly sub-adult/juveniles and small numbers of adult males and females (Fig. 7.19)

- Largest concentrations of seals were observed at Greencastle Point and Green Island (Fig. 7.19)

Figure 7.17: Waters Between Greenore Point and Greencastle Surveyed for Presence Of Marine Mammals

Figure 7.18 Seals Hauled-Out at Green Island

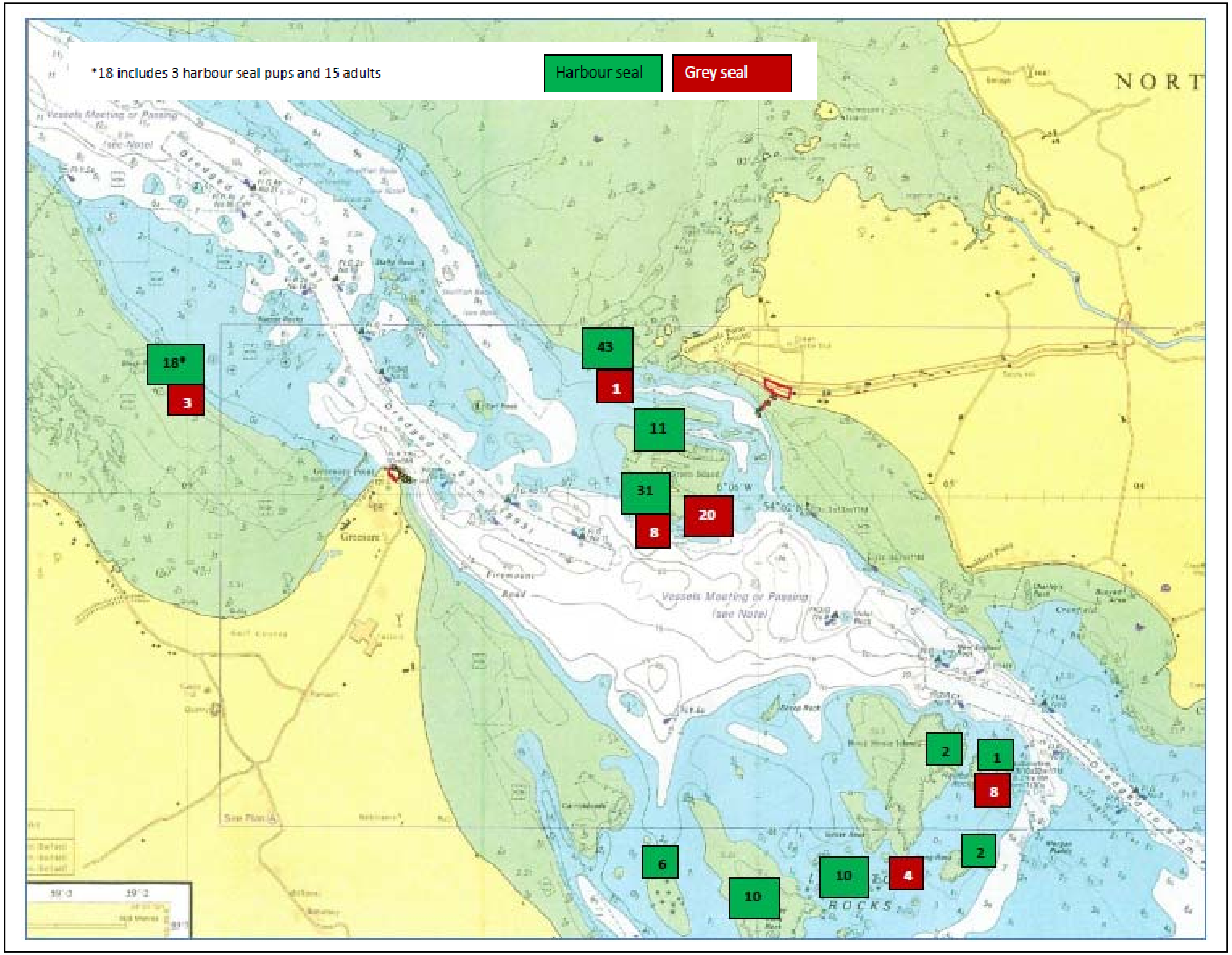


Figure 7.19: Seal Counts at Haul-Out Sites in Carlingford Lough During Boat Survey 25/06/2012

7.2.5 Impact Assessment

In light of the legislation and conservation status of marine mammals, careful consideration must be given during all anthropogenic activity with potential effect on the species and their habitat, having first determined what marine mammals use the area and surrounding waters, in order to estimate the likely risk of any impacts resulting from the proposed development. There are guidelines to the risk assessment process in both NPWS (2012) and JNCC (2010a, b) guidelines. ‘A risk assessment for each marine mammal species of relevance to the proposed works area needs to consider the nature of the sound source, its likely and/or potential effects on individuals and/or populations and on their likely habitats’ (NPWS, 2012). ‘Any risk assessment should start by considering whether any injury and/or disturbance offences are likely, based primarily on the nature, the duration and extent of the activity. While a short-term operation affecting a small area could result in an injury offence, it is more likely that a disturbance offence would occur as a result of a long-term operation or combination of operations’ (JNCC 2010d). The assessment of risk in this case is considered separately for the developmental phase and the operational phase.

The species most likely to be affected by disturbance during the development and operational phase of the proposed Carlingford ferry is the harbour seal (and grey seal to a lesser extent) based on proximity of terrestrial haul-out sites to the ferry route. Careful consideration therefore should be given to minimise impacts on this species at all stages of development and operation. Although harbour seals are by far the most abundant marine mammal species in the area harbour porpoises must also be considered due to the fact they are likely visitors to Carlingford Lough and considering their status as Annex II species under the Habitats Directive.

In-Combination Effects
All potential impacts have been addressed both independently and with regards to any other project or plan listed in Chapter 3 which together may adversely affect marine mammals.

7.2.6.1 Identification of Potential Impacts – Development Phase

The noise associated with the slip and pier developments represents a source of acoustic degradation in the marine environment. The planned works will involve piling primarily, no dredging or rock breaking is proposed.

Pile driving associated with the proposed development, is considered to be a potentially detrimental activity to marine mammals because it produces a very high source level and broad bandwidth sound. Sound produced during pile-driving propagates through the air into water, through the water column and, to a lesser degree, through the sediment and from there back into the water column (Thompson *et al*., 2006). Sound pressure levels in impact pile-driving are dependent on the length and the diameter of the pile and the impact energy (Nedwell *et al*., 2003) as well as the seabed conditions or substrate hardness. The response thresholds of cetaceans are usually the lowest for pulsed sounds and pile driving is one of the loudest sources of this type of noise (Richardson & Wursig, 1996). Piling noise (source levels) for piles with a diameter of between 4 and 4.7m has been estimated to range from 243 to 257 dB re 1 Pa @ 1m, with an average value of 250 dB re 1 Pa @ 1 m40. Low frequency sounds dominate pile driving.

Extended exposure to high levels of continuous noise and/or impulsive sounds with high rise times can lead to injuries of the hearing structures in cetaceans and pinnipeds resulting in permanent hearing loss and other injuries (Richardson *et al*., 1995). Such injuries have been linked to mid-frequency tactical sonar (Evans & Miller, 2004). Source levels of pile-driving noise are very similar to tactical sonar however they differ in duration, frequency content, duty cycle and directionality and it is therefore difficult to assess their potential for causing severe injury in cetaceans and pinnipeds. Animals close to the source, exposed to a sudden onset of pile-driving noise might be injured (Thompsen *et al*., 2006). Temporary threshold shift (TTS), a temporal elevation of the hearing threshold due to noise exposure, could be induced by exposure to pile-driving noise. Using a model impact pile-driving broadband sound pressure level of 229dB_{rms} re 1 µPa at 1m, the resulting TTS-zones are 1.8km for harbour porpoises and 400m for pinnipeds.

In addition to potentially injuring marine mammals, pile driving and industrial noise can adversely impact behaviour, communication and breeding. The radius of the zone of responsiveness to pile-driving noise has been provisionally defined as up to at least 20km for harbour porpoises and harbour seals (Thompsen *et al*., 2006). At 9kHz this noise is capable of masking strong dolphin vocalizations within 10-15km and weak vocalizations up to approximately 40km; behavioural modifications have been observed in bottlenose dolphins in response to noise produced by pile driving (David, 2006). Pile driving in the western Baltic found a significant, though temporary, effect on the haul-out behavior of harbour seals (Teilmann *et al*., 2006) and the abundance of echolocating harbour porpoise was found to decrease during pile driving activities in Denmark (Tougaard et al., 2003).

In summary the potential effects of *pile driving* on marine mammals include:

- Physical injury of individuals resulting from close range exposure
- Chronic hearing damage from short/medium range exposure
- Disturbance or displacement as a result of pile driving
- Long term effects resulting from habitat degradation
- Short term effects of sediment disturbance

Pile driving for the proposed development in Carlingford Lough is unlikely to affect either species of seal at the population level, however considering the proximity of several harbour seal haul-out sites to Greenore and Greencastle, and the fact that the zone of responsiveness to pile-driving noise has been provisionally defined as up to at least 20km for harbour seals, there is the potential for the above detrimental effects on individuals. Seals are more vulnerable to impacts of pile driving when they are in the water (once the haul-out is not in the immediate vicinity to the work zone). The proportion of time either seal species spends in the water varies seasonally therefore the risk will vary seasonally. Mitigation measures to reduce the risk of pile driving to seals are recommended in section 7.2.8.

‘For most cetacean populations in UK waters, disturbance is unlikely to result from single, short-term operations, e.g. a seismic vessel operating in an area for 4-6 weeks, or the driving of a dozen small diameter piles. Such activities would most likely result in temporary sporadic disturbance, which on its own would not be likely to impair the ability of an animal to survive, reproduce, etc, nor result in significant effects on the local abundance or distribution. Non-trivial disturbance, which would constitute an offence under the Regulations, would most likely result from more prevalent activities in an area, chronically exposing the same animals to disturbance or displacing animals from large areas for long periods of time. Examples of activities for which the risk of a disturbance offence should be assessed include commercial whale-watching and pile driving in one area for a long period of time. (JNCC 2010b)’ The proposed pile driving in Carlingford Lough consists of approximately 12 piles of 1.2m diameter at Greencastle and 7 piles of 1.2m diameter at Greenore (for a discrete period during construction activities); this is unlikely to have an adverse impact on cetaceans at the population level. However, ‘small-scale coastal pile driving (e.g., for the fixing of floating pontoons or temporary structures), while generally of less concern, may produce underwater sound at sound pressure levels up to 190 dB re: 1 SPa and at frequencies overlapping marine mammal hearing, thereby increasing the potential for auditory masking, avoidance and other disturbance effects’ (NPWS 2012). Transient cetaceans, in particular harbour porpoise and bottlenose dolphin, temporarily using the area will potentially be exposed to the noise produced by pile driving and precautionary measures are therefore recommended (see section 7.2.8).

7.2.6.2 Identification of Potential Impacts - Operational phase

There have been a number of studies on the effects of vessel movement on marine mammals (Baker et al., 1982; Polacheck & Thorpe, 1990; Janik & Thompson, 1996; Bejder et al., 1999; Nowacek et al., 2001; Evans 2003; Mattson et al., 2005). Research has shown that although a rare occurrence in UK waters, collisions do occur between marine mammals and ships/boats operating at speed, which may result in fatal injuries or wounding. However, quantified information on the occurrence of these incidents is very limited. From the UK, reports have been received of direct observation of collisions with minke whale, sperm whale and long-finned pilot whale and evidence of non-fatal propeller cuts observed in killer whale, bottlenose dolphin, short-beaked common dolphin, white-beaked dolphin and harbour porpoise (Evans, 2003). While most reported incidents in the US concern large whales and in particular fin whales (29.2% of recorded collisions), collisions with smaller species also occur (van Waerebaek *et al*., 2007; Waerebeek and Leaper, 2008).

Injuries from vessel collision include lacerations from propellers and blunt traumas from impact with the hull. Blunt traumas can result in fractured skulls, jaws or vertebrae, in conjunction with large haematomas. It is possible that if these injuries do not cause the immediate death of the animal they will leave it vulnerable to death from secondary infections, complications or predation. Behavioural reactions to boat noise from marine mammals can include both avoidance (e.g. diving to deeper water) and attraction (e.g. turning into the path of a vessel) and depend upon a number of unpredictable factors; including species, age class, behavioural state at the time of the encounter, the sound properties of the approaching vessels, and other factors (ACCOBAMS, 2005). Bejder et al. (1999) expressed concern that dolphins that are forced to spend a great deal of time and energy avoiding boats may end up with reduced biological fitness as a consequence of the disruption of critical energy budgets.

A summary of the International Whaling Commission (IWC) global database of collision incidents reported that serious injury and death in a range of cetaceans was most commonly recorded associated with vessels travelling at speeds between 15 to 45 knots and between 100 and 250 metres in length (Waerebeek and Leaper, 2008). The probability of lethal injury to whales drops below 0.5 at 11.8 knots and 0.17 at 8 knots (Vanderlaan and Taggart, 2007).

Risk management measures have been identified in ACCOBAMS[2] (2005) including measures associated with vessel operations (i.e. dedicated MMOs aboard or trained crew, and detection instrumentation) and measures associated with vessel navigation (i.e. speed restrictions and shipping lanes). Of these measures seasonal speed restrictions of 10 knots have been applied in certain circumstances e.g. off the US coast where particularly endangered whales are at risk (e.g. NOAA, 2008) and are believed to be effective at reducing risk if properly implemented. Dedicated Marine Mammal Observers (MMOs) and trained staff have been effective at reducing collisions off the US coast (Weinrich et al., 2010).

In UK waters, the issue of injury through collision is not currently thought to be of major concern and so there are no specific mitigation measures in place. The risk of disturbance under the Regulations, as a result of the potential cumulative effect of shipping, requires further investigation as does the matter of whether in certain areas, particularly those where chronic exposure is a possibility, the adoption of guidelines and mitigation measures would be appropriate (JNCC 2010a). There are no specific mitigation/risk management measures in relation to marine mammals and vessel collision recommended by the regulatory authorities in the Republic of Ireland.

7.2.6 Prediction of Impact Magnitude and Assessment of Significance

7.2.6.1 Development phase

The proposed pile driving in Carlingford Lough consists of approximately 12 piles of 1.2m diameter at Greencastle and 7 piles of 1.2m diameter at Greenore (for a discrete period during construction activities); this is unlikely to have an adverse impact on cetaceans at the population level. However, ‘small-scale coastal pile driving (e.g., for the fixing of floating pontoons or temporary structures), while generally of less concern, may produce underwater sound at sound pressure levels up to 190 dB re: 1 SPa and at frequencies overlapping marine mammal hearing, thereby increasing the potential for auditory masking, avoidance and other disturbance effects’ (NPWS 2012). Transient cetaceans, in particular harbour porpoise and bottlenose dolphin, temporarily using the area will potentially be exposed to the noise produced by pile driving and precautionary measures are therefore recommended (see section 7.2.8).

Whilst the scale of the piling is relatively small, given the importance of the area for seals (in particular harbour seals) and the proximity of breeding and moulting sites to the area of proposed works, a precautionary approach is advised and risk avoidance and mitigation measures in relation to pile driving are advised, giving consideration to measures proposed by JNCC (2010a,b) and NPWS (2012).

The species most at risk from the proposed works in the area are harbour seals (to a lesser extent grey seals); it is proposed that the development phase avoids the breeding season for harbour seals

[2] Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area

(June-July). The moult is the period when seals remain ashore for extended periods and for harbour seals this occurs in August/September so this would be the optimal period for conducting piling as seals are spending less time in the water and therefore at less risk from acoustic disturbance.

7.2.6.2 Operational phase

It is anticipated that a ferry with a maximum capacity of approx 40-60 cars will be operated in Carlingford Lough. The ferry would be approximately 60-80m long, up to 15m beam and up to 2.5m laden draught with a top speed of approximately 8-12 knots depending upon specification. The ferry is expected to operate on an hourly basis from each side commencing around 6:30-7am and finishing around 8:30-9pm but with curtailed hours during the winter season. There are potential negative impacts of the ferry operations on marine mammals in the area.

The species most at risk of vessel collision in Carlingford Lough, based on abundance, foraging range and behaviour is the harbour seal. Other marine mammal species that are potentially at risk (albeit lower risk than harbour seals) based on sightings data and what we understand of species ecology in Irish waters, include bottlenose dolphin and harbour porpoise. There could also be indirect effects of vessel activity that may not be immediately obvious but could have long-term effects on harbour seals at (local) population level, including disturbance at seal haul-out sites and/or masking of biologically relevant sounds (e. g. social vocalizations). The mating strategy for the harbour seal is based on males diving and calling at aquatic display sites (Van Parijs *et al.,* 1997; Hayes *et al*., 2004). Disturbance from anthropogenic noise during this period could therefore potentially affect mating success. Long-term effects of noise and disturbance at population level may be lower reproductive rates or lower survival rates of juveniles if disturbance occurs on a regular basis during the mating season or during the rearing of the young. The breeding season of harbour seals is July and August (Van Parijs et al. 1997). This coincides with peak holiday season, and thus the period in which the greatest number of personal water craft and ferries are presumably in operation. Moreover pupping sites in Carlingford Lough are in close proximity to the proposed vessel route (Fig. 7.15). It is possible that over time the seals will habituate to the ferry, as observed at other sites e.g. southwest Ireland (pers. Obs), however this will take time and caution should be taken to ensure disturbance is minimal in the initial phases of operation, to avoid seals 'abandoning sites' to relocate elsewhere. Details on suggested mitigation measures to minimise disturbance from the ferry are provided in sections 7.2.8.2 and 7.2.9.

7.2.8 Mitigation Measures

Risk management measures considered are based on both NPWS and JNCC guidelines (JNCC 2010 a, b, c; NPWS, 2012) and expert opinion. The following risk mitigation measures outlined are based on specific guidance provided by NPWS on minimising risk to marine mammals from pile driving operations. For comprehensive information on the guidelines refer to NPWS (2012). Mitigation measures during both development and operational stages are suggested:

7.2.8.1 Development Stage

- A qualified and experienced marine mammal observer (MMO) should be appointed to monitor for marine mammals and to log all relevant events using standardised data forms

- In waters up to 200m deep, the MMO should conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence, continuing monitoring during and for 30 minutes following the activity. Sound-producing activity should not commence until at least 30 minutes have elapsed with no marine mammal detections by the on-site MMO

- Unless information specific to the location and/or operation/activity is otherwise available to inform the mitigation process (e.g., sound attenuation data), operations should not commence if marine mammals are detected within a 1,000m* radial distance of the intended sound source, i.e., within the Monitored Zone.

- If there is a break in pile striking /drilling activity for a period greater than 30 minutes then all pre-piling monitoring measures and ramp-up (where this is possible) should recommence as for start-up.

- Full reporting on MMO operations and mitigation undertaken should be provided to the Department of Arts, Heritage and the Gaeltacht to facilitate reporting under Article 17 of the EC Habitats Directive and future improvements to guidance. Details are given in NPWS (2012)

- The regulatory authorities may also wish to consider the JNCC guidelines (JNCC 2010 a,b) which generally concur with those listed above.

  **Radial distance could be reduced to 500m if 1000m is impractical, considering the proximity to seal haul-out sites and the small scale and short term nature of the proposed operation. 500m is the minimum distance of the mitigation zone recommended by JNCC (2010b). It is recommended that further guidance is sought from the regulatory authorities on this matter.*

7.2.8.2 Operational Stage

Based on international studies and best practice the following mitigation/risk management measures are recommended to minimise risk of disturbance and collision.

- Subject to agreement with the relevant regulatory authorities it is recommended that speed restrictions of 10 knots be applied to the ferry in Carlingford Lough. This measure should reduce the probability of a collision causing a lethal injury. It will also reduce the potential of wash at haul-out sites near the vessel route (e.g. Green Island, Greencastle Point) which may cause disturbance to hauled-out seals.

- Various codes of practise operate in specific areas to minimise disturbance/risk of collision to marine mammals eg. Shannon Estuary in Co. Limerick/Co. Kerry; Scottish Marine Wildlife Code (www.marinecode.org) and such a code could be developed for the Lough to minimise collision and disturbance risk.

- In addition, any accidental collision should be reported to the relevant authorities, such as to NIEA and NPWS.

- To reduce potential of disturbance of seals at haul-out sites, particularly during the breeding and moulting periods (July-September) it is recommended that the ferry route is located a minimum distance of 500m** from seal haul-out sites (identified in Fig. 15).

- To monitor potential disturbance/redistribution of seals at haul-out sites it is recommended that monthly surveys of seal haul-out sites are conducted prior to and during the operational phase. Ideally surveys would be conducted 12 months prior to the operational phase to provide baseline data however if this is not possible existing datasets (SMRU, NIEA, TSR, Loughs Agency) could be used to compare to data gathered during the operational phase.

  *** This distance could be reduced to minimum of 300m if seals were observed not to be disturbed at 500m. 300m is regarded as the ‘caution zone’ in code of best practice for watching marine wildlife in UK waters*

7.2.9 Residual Impacts

It is unlikely that there will be residual impacts from the development stage of the project considering the relatively small scale nature of the proposed works, however there is potential for the ferry operations to have a residual impact on marine mammals in the area as the disturbance will be on-going. However as stated earlier it is possible that seals will habituate to the ferry operating in the vicinity of haul-out sites and ideally not abandon sites or return to sites that they initially abandoned during start-up of ferry operations. Seals may be very tolerant to recurring disturbances that do not pose a threat (Edren et al., 2010). It is impossible to predict how the seals will react to the ferry passing at close proximity to the haul-out sites as response of seals varies with vessel type, speed, approach angle, time of year amongst other factors. It would be best to take a precautionary approach and have a zone of exclusion from haul-out sites initially set at 500m but this could be reduced to a 300m zone of caution after a period of time should the seals show no obvious signs of disturbance. This includes at worst animals abandoning sites/animals frequently entering the water to animals repeatedly raising their heads and looking around (less obvious signs of disturbance).

7.3 Fisheries and Aquaculture

7.3.1 Introduction

Carlingford Lough is a flooded river valley that lies between the Mourne Mountains to the north, and Carlingford Mountains to the south, and straddles the border between Ireland and Northern Ireland. The catchment of the lough extends over an area of 474 km^2 and the principal freshwater input is the Newry River which discharges at the head of the lough. Additional freshwater inputs are the Moygannon, Kilbroney, Cassy, Ghann and Ryland rivers.

This section describes the fisheries interests of the Carlingford Lough and the Mourne shore area under four headings:

- Existing Environment
- Shellfish Aquaculture
- Sea Fisheries
- Sea Angling
- Migratory Salmonids

The major fisheries feature of Carlingford Lough is the shellfish aquaculture industry for production of the bivalve molluscs, Blue mussel (*Mytilis edulis*) and Pacific oyster (*Crassostrea gigas*). There is also some pot fishing in the area for crab and lobster, and the Mourne Shore herring fishery is located nearby. Other significant fisheries interests in the area are the movement of migratory salmonids (sea trout and salmon) to and from rivers discharging to Carlingford Lough, and a growing interest in sea angling in the lough, notably for tope.

7.3.2 Methodology

This assessment is based on information on the proposed works provided in the Project Description (Chapter 3) of this ES/EIS. Site visits were also carried out at the location of the proposed ferry terminals at Greenore and Greencastle and consultations were conducted with the following statutory bodies/agencies and local representatives:

- Loughs Agency
- Agri-Food & Biosciences Institute (AFBI)
- Sea Fisheries Protection Authority (SFPA)
- Department of Agriculture & Rural Development (DARD) – Fisheries Division
- Ferguson Shellfish
- Local lobster fisherman

The report is based on information collected through these consultations, information from published and unpublished literature, and professional judgement based on experience in the field of fisheries.

7.3.3 Existing Environment

7.3.3.1 Statutory Authority

Under Section 11 (6) of the Foyle Fisheries Act (Northern Ireland) 1952, and the Foyle Fisheries Act 1952 (Republic of Ireland), the Foyle Fisheries Commission was given the responsibility for “the conservation, protection and improvement of the Fisheries of the Foyle Area generally”. The North/South Co-operation (Implementation Bodies) (Northern Ireland) Order 1999 and the British Irish Agreement Act 1999 extended these functions to include the Carlingford Area, and the Foyle Fisheries Commission transferred its functions to the Loughs Agency.

The Loughs Agency is an agency of the Foyle, Carlingford and Irish Lights Commission (FCILC), established under the 1998 Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Ireland.

The extended functions of the Loughs Agency include the development of aquaculture and marine tourism as stated in one of the principal objectives:

- "To promote the development of Lough Foyle and Carlingford Lough for commercial and recreational purposes in respect of marine, fishery and aquaculture matters”

7.3.3.2 Shellfish Waters Directive

The EC Shellfish Waters Directive (2006/113/EC) requires member states to designate waters that need protection in order to support shellfish life and growth. It is designed to protect the aquatic habitat of bivalve and gastropod molluscs, and sets physical, chemical and microbiological requirements which designated waters must either comply with or endeavour to improve.

The full extent of Carlingford is designated under this directive due to its economic significance for shellfish production. As the lough is bisected by the border two separate designations were required to cover the relative areas of the water body in Ireland and Northern Ireland. Designated waters are afforded greater protection and their water quality is monitored by the NIEA in Northern Ireland and the EPA in Ireland according to the requirements of the directive.

The Shellfish Directive will be repealed in 2013 by the EC Water Framework Directive, which will provide at least the same level of protection to shellfish waters within the context of the River Basin Management Plan process.

7.3.3.3 Bathymetry

AFBI are scheduled to conduct a detailed bathymetric survey of the Lough this under the Inis Hydro Project http://www.inis-hydro.eu/surveys. However the nearshore sub-tidal habitat of Carlingford Lough has previously been mapped by Department of Agriculture and Rural Development (DARD) and Queens University Belfast (QUB) as part of an exercise carried out for Environment & Heritage Service (now NIEA). Details of the habitat codes are outlined in Appendix 7.5 and the Carlingford map is summarised in the following extract from the report Mitchell & Service (2003):

The Lough extends 15 km in length from the mouth to Warrenpoint in the Northwest, and reaches 5km in width at its widest point. The lough is mainly shallow with some deeper, narrow channels that run along the centre of the lough. There is an extensive intertidal area (14.9km2) and shallow subtidal area that supports a wide variety of aquaculture, including the cultivation of mussels, oysters, clams. The deeper rocky areas towards the mouth of the lough support lobster and crab pot fishing.

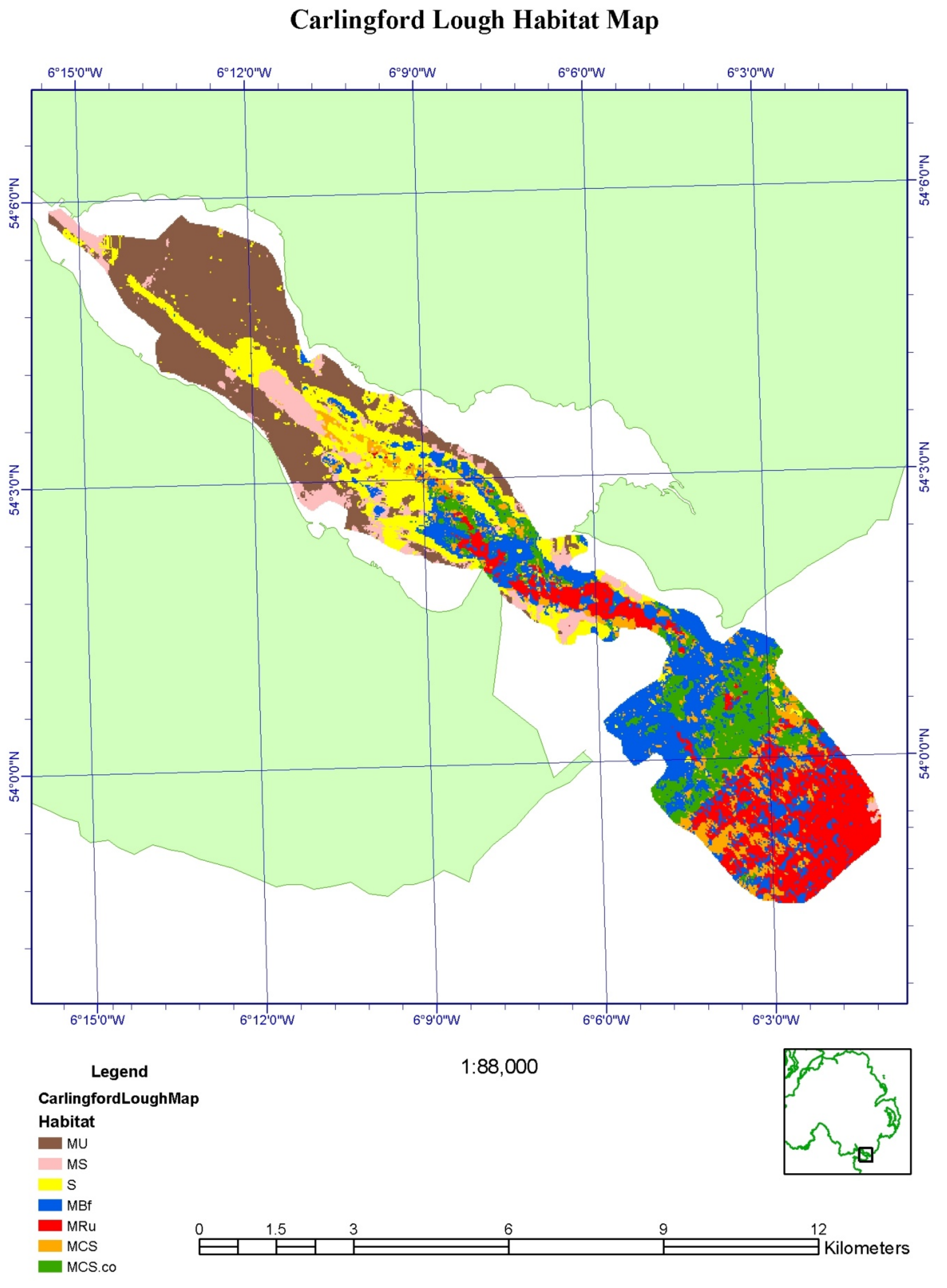
The habitat map (Figure 7.20) shows that there is a strong energy regime influencing the habitat distribution throughout the Lough: mud dominates the upper reaches of the lough, except for the main dredged channel which is comprised of sand and muddy sand sediments. The central lough is dominated by the sand habitat with the central channel comprising of coarse sands and gravel. Near the mouth of the lough rock and cobble habitats dominate, influenced by the fast-moving water at the narrow entrance to the lough that suspends any finer sediment. Seawards of the lough entrance the seabed is dominated by rock and cobble substrates, interspersed by patches of coarse sand and gravel. Either side of the narrow mouth, the substrate is often covered by a fine layer of silt.

7.3.3.4 Shellfish Aquaculture

Shellfish aquaculture is now a significant industry on the Irish coast and Carlingford Lough is a major centre of production with 25 licensed areas, mainly for the production of Mussels *Mytilus edulis*, and Pacific oyster *Crassostea gigas*. Limited cultivation of Manila clam (*Tapes semidecussata*) and Scallop (*Pecten maximus*) has also taken place in previous years (Taylor *et al,* 1999).

Figure 7.21 shows the location and type of areas licensed for shellfish production in the lough; currently there are 10 licensed areas in NI waters and 15 in ROI waters. The route of the car ferry may encroach on a licensed oyster site and a scallop site, both also on the northern side of the lough, although the scallop site appears to be no longer in production. There is also a major shellfish production sites to the north and south of Greenore within 500m of the route.

Figure 7.20: Carlingford Lough Habitat Map



Production and revenue

Production figures for both jurisdictions for the years 2002-10 are presented in Table 7.3.1 total production summarised graphically in Fig 7.22.

Table 7.3.1: Aquaculture Production from NI And ROI Areas of Carlingford Lough, 2001-05; Production Volume And Estimated Value (Sources BIM; DARD)

Region	*Year*	*Mussel*		*Oyster*		*Combined*	
		Volume (t)	*Value*	*Volume (t)*	*Value*	*Volume (t)*	*Value*
ROI	2002	1,600	€1,920,000	840	€1,364,020	2,440	€3,284,020
	2003	2,700	€2,787,500	377	€680,350	3,077	€3,467,850
	2004	2,500	€2,468,000	320	€730,000	2,820	€3,198,000
	2005	4,300	€4,862,500	561	€1,096,500	4,861	€5,959,000
	2006	5,549	€10,626,800	573	€1,235,745	6,122	€11,862,545
	2007	5,160	€7,646,000	268	€622,800	5,428	€8,268,800
	2008	3,905	€4,959,890	408	€798,801	4,313	€5,758,691
	2009	4,796	€3,819,554	405	€895,374	5,201	€4,714,928
	2010	3,300	€1,897,000	420	€1,084,024	3,720	€2,981,024
NI	2002	260	£352,500	35	£25,950	295	£378,450
	2003	310	£182,500	38	£40,500	348	£223,000
	2004	1,182	£690,150	47	£55,500	1,229	£745,650
	2005	1,260	£1,077,000	52	£61,500	1,312	£1,138,500
	2006	2,110	£2,810,000	101	£160,500	2,211	£2,970,500
	2007	1,530	£1,878,000	107	£195,800	1,637	£2,073,800
	2008	2,186	£2,230,890	0	£0	2,186	£2,230,890
	2009	2,970	£1,311,250	132	£211,200	3,102	£1,522,450
	2010	1,350	£582,000	120	£330,000	1,470	£912,000

Total shellfish production has risen from 2,735 to a peak of 8,333 tonnes in 2006 with an overall value of over £11 million. However the most recent data from 2010 indicates that production has been reduced to 5,190 tonnes at a value of less than £3.5 million. A new shellfish depuration plant to service the industry in Carlingford was opened during 2006 at Warrenpoint Harbour.

Figure 7.21: Location and Type of Aquaculture Licences in Carlingford Lough (NI & ROI)

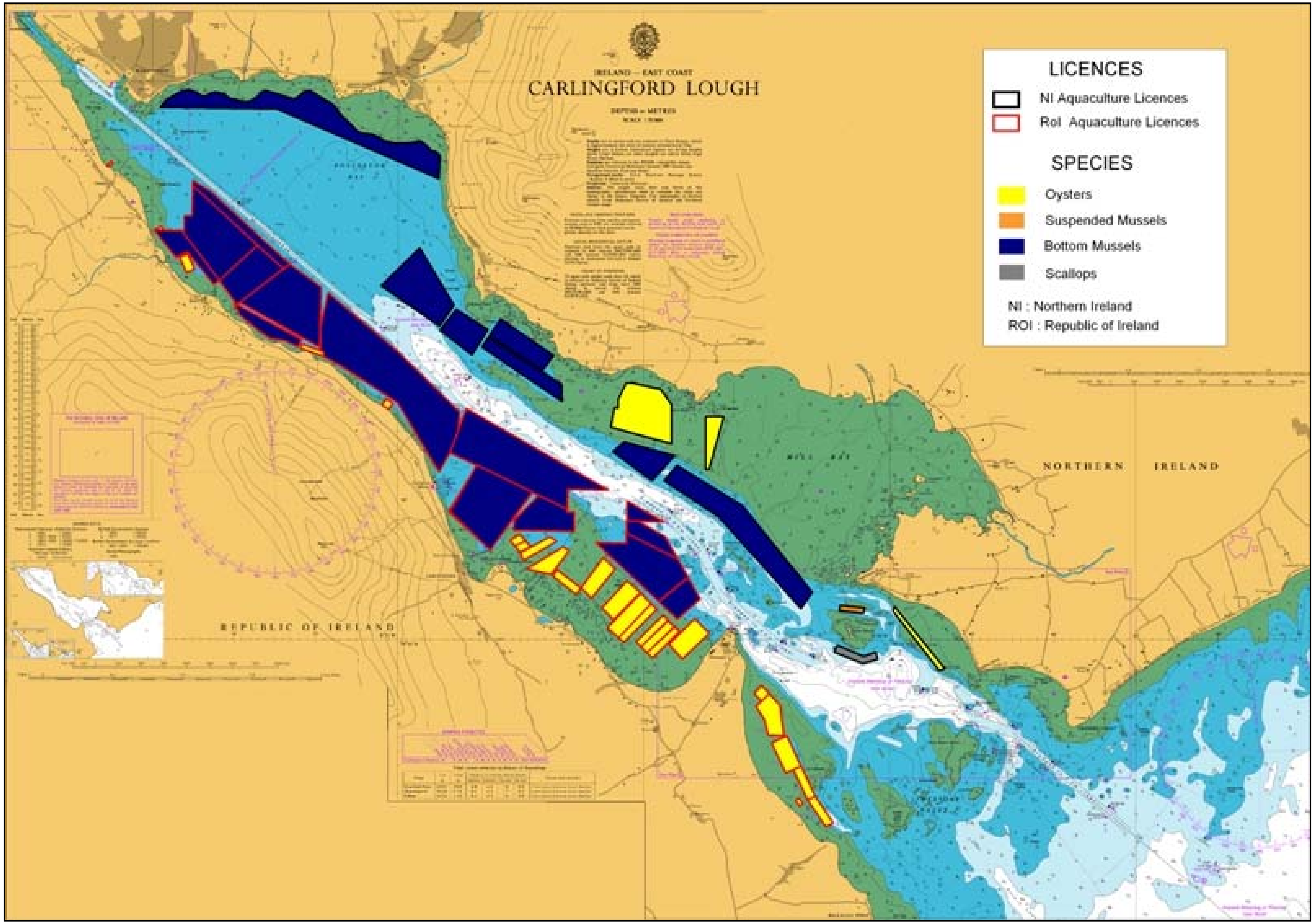


Figure 7.22: Total Shellfish Production in Carlingford Lough 2002-10; Live Weight (Tonnes) and Value (£) (Sources BIM; DARD)

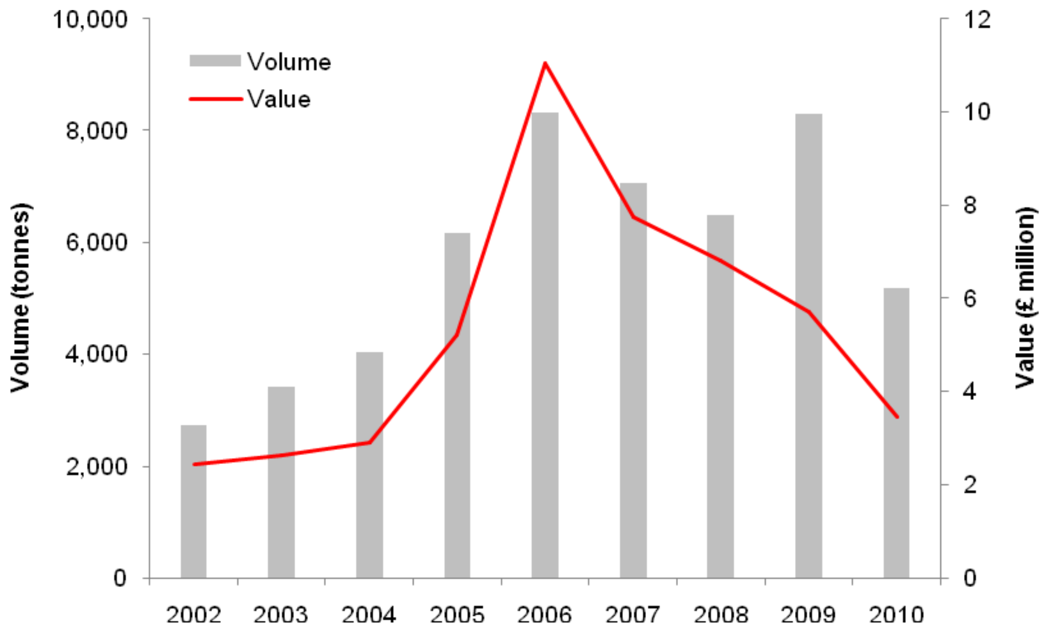
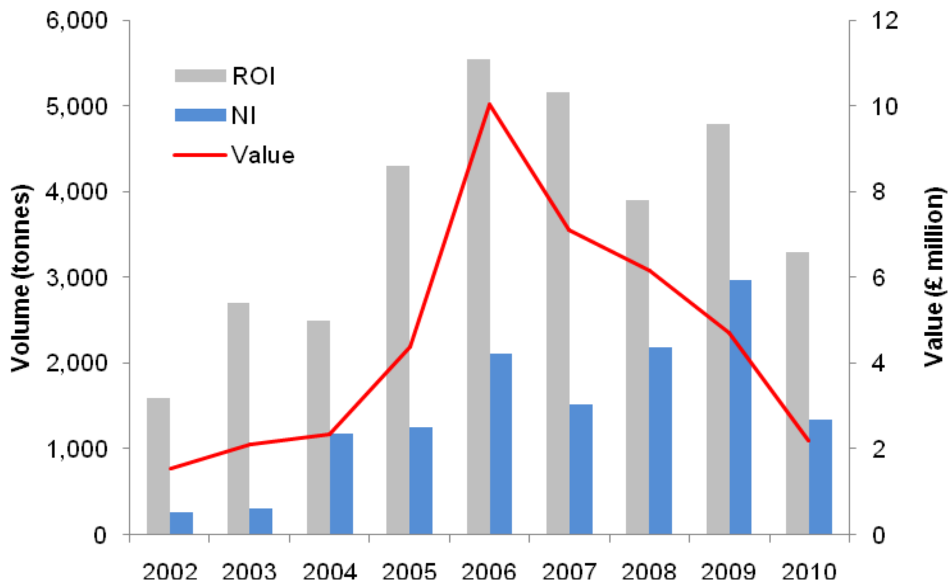


Figure 7.23: Mussel Production in Carlingford Lough 2002-10; Live Weight (Tonnes) And Value (£) (Sources BIM; DARD)



Blue Mussel

Mussel farming is based on the bottom culture of mussels laid as seed (or spat) for growing on to harvest size. The spat is dredged from known areas around the Irish coast where it has settled in abundance, mostly along the south-east coast from Dublin to Wexford - this takes place between July and November. The seed is then transferred to prepared areas where it is re-laid at lower density to promote improved growth and meat content. Harvesting of mussels is generally between November and March but can occur throughout the year.

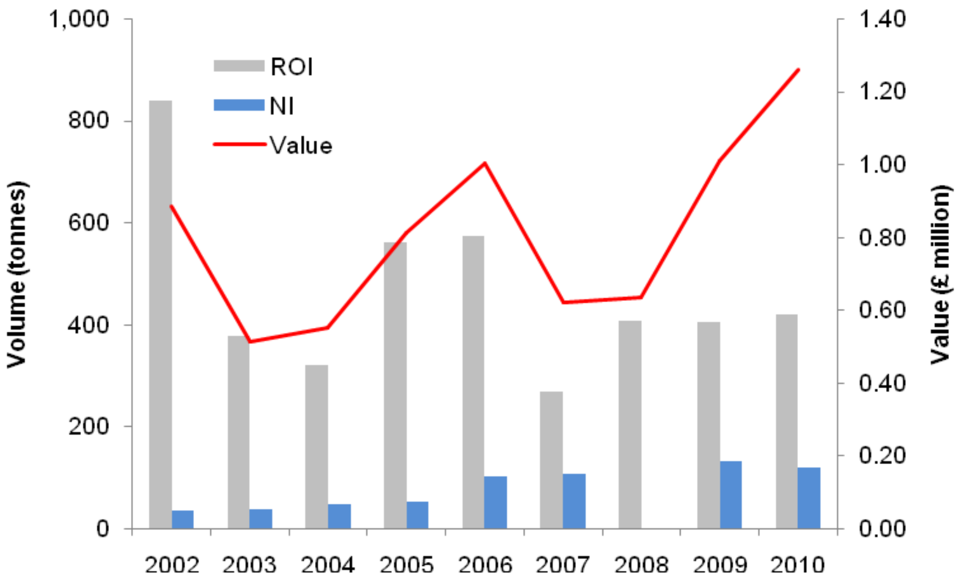
Mussel cultivation is very much constrained by the availability of seed mussel which has been unable to fully meet the demands of the industry through a period of rapid expansion. Most of the seed mussel for the industry is dredged from the south west Irish Sea, and a Seed Mussel Allocation Committee (SMAC) comprising representatives from BIM, DCENR, DARD, CBAIT and the Loughs Agency considers the supply and allocation of seed to licensed growers throughout Ireland.

Production is dominated by mussel which has rose to 7.66 tonnes in 2009 with a sale value of over £10 million (Fig 7.23). Production has since been scaled back to some degree mainly due to a fall in prices which has seen the sale value decline annually to £2.2 million by 2010; a shortage of seed mussel may also have been a factor in the reduced level of production.

Pacific Oyster

Pacific oyster is a non-native species which does not spawn naturally in local waters. The industry therefore depends on specialist hatchery producers for the supply of seed for on-growing in coastal areas. Oyster seed is imported during the summer and the oysters are grown in plastic mesh bags secured to metal trestles in the inter-tidal zone or low-water mark. The oysters feed on natural phytoplankton and reach market size of 70-100g in 2-3 years. The produce is harvested during the winter months for sale to specialist outlets in Europe.

Figure 7.24: Pacific Oyster Production in Carlingford Lough 2002-10; Live Weight (Tonnes) and Value (£) (Sources BIM; DARD)



Oyster production has remained more consistent with an average output of over 500 tonnes (Fig 7.24). In contrast to mussel, oyster prices have increased significantly and turnover value has increased by 150% since 2003 to £1.26 million in 2010.

7.3.3.5 Sea Fisheries

Fleet

The size and composition of the Northern Ireland fishing fleet has changed over the last 10 years with an increase in the number and proportion of vessels of less than 10m in length, and a decrease in the numbers of vessels in excess of 10m. Much of the decline in the fleet has been in the whitefish sector due to the decline in whitefish stocks, which has resulted in successive quota cuts, reductions in fishing days, and the closure of the Irish Sea cod spawning grounds every spring since 2000.

The smaller vessels under 10m tend to operate on daily trips fishing in inshore waters, and their number has risen from 44% of the fleet in 1995 to 59% in 2005. This shift in focus has been particularly marked in Kilkeel where the number of small vessels has more than doubled from 34 to 71 boats and now comprises more than half of the locally based fishing fleet. The inshore sector has therefore become of increased significance in recent years and is an important source of income in this area of the coast.

Landings

Landings from monthly shellfish returns and logbook returns to DARD have been compiled for the Mourne Shore area (ICES rectangle 37E4; sub-rectangle 3) and Carlingford Lough (ICES rectangle 37E3; sub-rectangle 9) for 2009-11. These figures are presented in Table 7.3.2 and would suggest that fishing activity by small vessels in the area has produced a consistent average of 436 tonnes of live weight fish over the last three years with an annual value of up to £323,000. The catch is made up largely of shellfish (brown crab, green crab, mussel) and herring.

Pot Fisheries

The local pot fishery for shellfish in the Kilkeel/Mourne area is a major feature of the inshore sector, targeting lobster, brown crab, velvet crab, whelk and some pot-caught Nephrops. The Co Down coast is considered to be the most productive area for brown crab in NI waters. There are 24 boats under 10m in length fishing the inshore area along this coast on a full-time basis and involving 37 fishermen, with a further 15 boats fishing the area during the summer/autumn period. However, only a few fishermen operate in the area of the proposed ferry crossing, and the major species taken in and around Carlingford Lough are brown crab, green crab and lobster. The lost productive potting areas in the Lough are around Halpin Rock, Earl Rock and Green Island.

Pot fishermen in this area are represented by the North-East Lobster Fisherman's Co-operative Society Ltd (NELCO), which was founded in 1995 and has an overall membership of 60. NELCO's stated objectives are to forward, protect and enhance the interests of shell fishermen on this coast to provide a long term sustainable future. The range of the pot fishery is restricted somewhat by the size of boats involved (less than 10m), as they tend to operate on daily trips and therefore cannot venture far from their harbour base.

NELCO has received funding for stock enhancement through a "V"- notching programme which has been in operation since 1999. "V"- notching is a method of preserving lobster stocks which originated in the US and involves the return of egg-bearing female lobsters after cutting a "V"- notch in the tail flap. If subsequently recaptured, a "V"- notched lobster must be returned to the water live. The scheme is now protected by legislation making illegal to land a "V"- notched lobster which can lead to a maximum fine of £5,000. Fishermen are compensated by receiving half the market value of each lobster returned to the water. Since commencing this scheme, members of NELCO have released over 16,000 egg-bearing females to a value in excess of £300,000. It is likely that the fishery is now benefitting by catching the progeny of those released at the outset of the scheme.

Similar "V"- notching programmes are in operation on the north coast and in Donegal. In 1999 NELCO also purchased 1,500 juvenile lobster (cost £1,800); these were released to enhance local stocks in the area of the fishery.

Table 7.3.2: Sea Fishery Landings from Carlingford Lough And Mourne Shore Area; Live Weight and Value (Source DARD) (FPO – Potting; HMD – Mechanical Dredge; GN – Gill Netting; LHP – Handlines Etc)

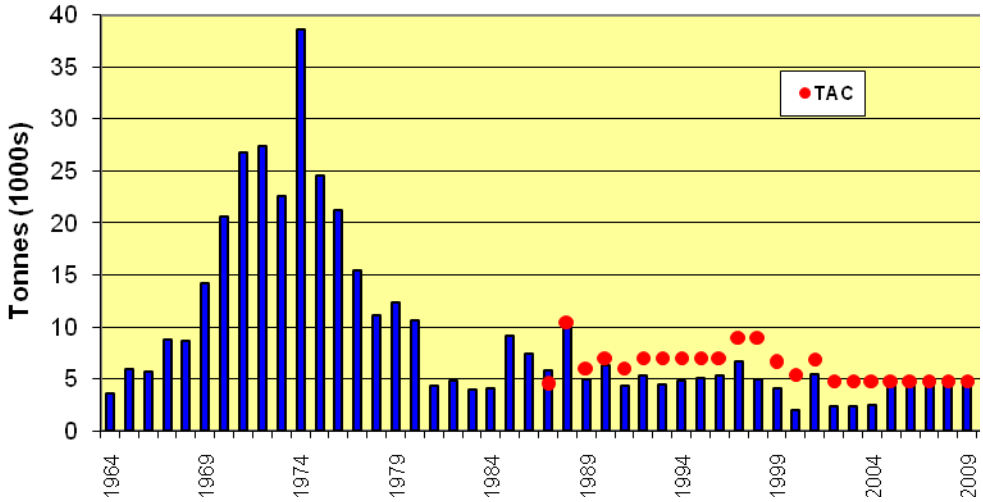
Fishery	*Gear*	*Species*	*2009*		*2010*		*2011*	
			Weight (t)	*Value (£)*	*Weight (t)*	*Value (£)*	*Weight (t)*	*Value (£)*
Carlingford L ICES rectangle 37E4	FPO	Brown Shrimp	0.01	£195	0.13	£1,890		
(sub-rectangle 3)		Velvet crab	1.68	£2,406	1.75	£2,581	2.06	£3,939
		Brown crab	10.34	£6,763	18.83	£13,539	1.53	£1,048
		Green Crab	67.95	£22,189	87.14	£33,970	26.09	£7,823
		Lobsters	1.23	£9,522	1.31	£6,984	0.98	£8,015
		Turbot	0.15	£619	0.61	£3,372		
		Whelks	0.06	£35	2.00	£1,202		
	FPO Total		**81.42**	**£41,729**	**111.78**	**£63,538**	**30.65**	**£20,825**
	HMD	Mussels	33.00	£36,543	2.00	£1,700	54.50	£36,982
	LHP	Mackerel			0.12	£60		
	Total		**114.42**	**£78,272**	**113.90**	**£65,298**	**85.15**	**£57,807**
Mourne Shore ICES rectangle 37E3	FPO	Brown Shrimp	0.21	£2,911	2.15	£21,861	0.12	£2,003
(sub-rectangle 9)		Velvet crab	4.21	£6,000	9.61	£13,590	4.93	£7,208
		Brown crab	133.89	£100,488	173.29	£133,093	157.35	£126,231
		Lobsters	2.59	£21,152	4.96	£45,200	2.85	£25,498
		Whelks			10.23	£6,435	1.42	£1,064
	FPO Total		**140.90**	**£130,551**	**200.23**	**£220,179**	**166.67**	**£162,003**
	GN	Herring	170.61	£33,810	129.15	£26,220	147.55	£35,895
	LHP	Mackerel	3.14	£1,572	19.81	£11,058	17.93	£13,133
	Total		**314.64**	**£165,933**	**349.19**	**£257,457**	**332.15**	**£211,031**
Overall Total			**429.06**	**£244,205**	**463.09**	**£322,755**	**417.30**	**£268,838**

There is considerable potting activity on licensed aquaculture areas in Carlingford Lough to remove green crab which are a significant predator of bottom grown mussel. Annual landings of up to 87 tonnes have been recorded in the last three years (Table 7.3.2).

Herring

Herring (*Clupea harengus*) is a locally important species as part of the Irish Sea herring stock complex which supported a major fishery from 1969 to 1980 and still operates at a lower level (Fig 7.25).

Figure 7.25: Irish Sea Herring Landings 1961-2004
(Source: ICES)



This is an autumn spawning stock comprising two separate spawning groups, Manx and Mourne. The Mourne herring spawns off the east coast of NI/ROI, in an area extending approximately from St John's Point (Co Down) south to Dunany Point (Co Louth) – this area includes Carlingford Lough and the proposed ferry crossing area.

During the early 1970s there was a significant expansion in the Irish Sea herring stock size but increased fishing effort resulted in subsequent reductions in spawning stock biomass and recruitment (Figure 7.26 & 7.27).

Figure 7.26: Irish Sea Herring: Spawning Stock Biomass (SSB)
Mean = 13,260t (Source: ICES)

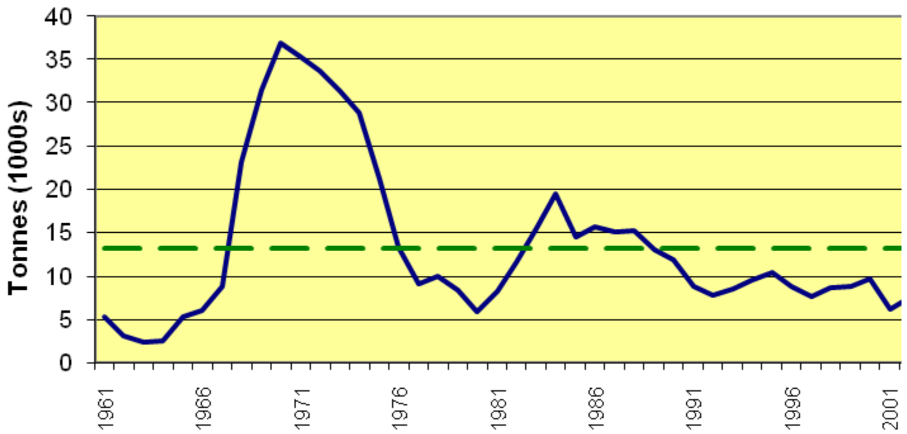
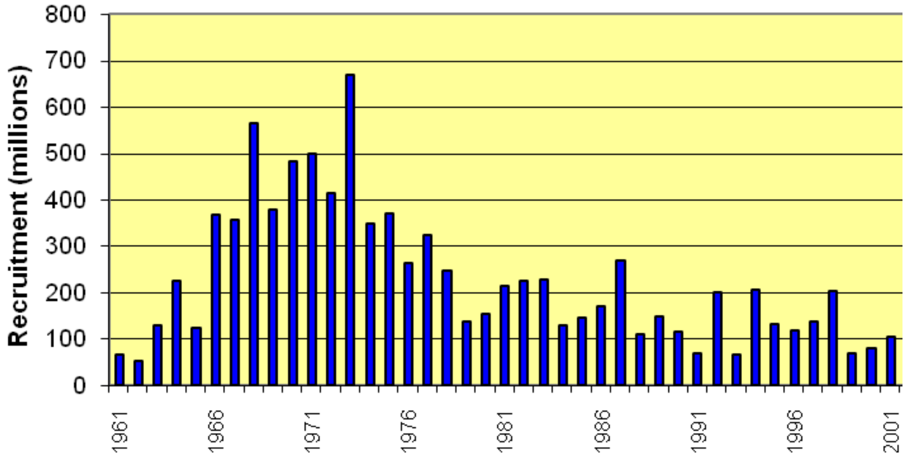


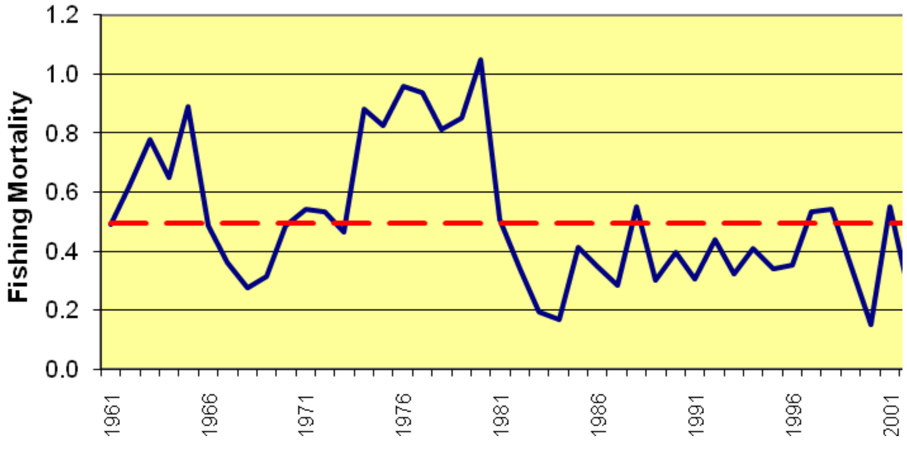
Figure 7.27: Irish Sea Herring: Recruitment (age 1)
(Source: ICES)



Locally the fishery developed around the autumn spawning migration to the Mourne area, and during this period the catch of Mourne herring made up over a third of the total Irish Sea catch. This fishery was carried out by NI and ROI vessels using trawls, seines and drift nets, but it declined and ceased in the early 1990s (ICES, 1994).

The Irish Sea stock complex experienced very low biomass levels in the late 1970s with an increase in the mid-1980s after the introduction of TACs and quotas. The stock then declined from the late 1980s to its present level. During this time period the contribution of the Mourne spawning component has declined and the biomass of Mourne herring, determined from larval production estimates, is now 2-4% of the total Irish Sea stock (Dickey-Collas *et al*, 2001). Reduced fishing effort has resulted in a lowering of fishing mortality which appears to be at historic low levels in recent years (Figure 7.28) (ICES 2005).

Figure 7.28: Irish Sea Herring: Fishing Mortality (ages 2-6)
Mean = 0.49 (Source: ICES)



There are a number of restricted areas protected by EU legislation to preserve the spawning stock during the spawning season and to prevent the exploitation of juveniles. This includes the Mourne Box which was closed completely to herring fishing during the early 1990s. Subsequent legislation in 1998 now permits a traditional fishery based on vessels not exceeding 12.2m (40 ft) operating from 21 September to 31 December, and using only drift nets of specified minimum mesh size (EC 1998).

Table 7.3.3: Mourne Shore Herring Fishery; Quota Allocation and Landings; 2005-12 (Source: DARD; Marine Management Organisation - MMO)

Year	Opening allocation (tonnes)	End year allocation (tonnes)	End year landings (tonnes)
2000	40.0	40.0	0.0
2001	30.0	30.0	0.0
2002	30.0	30.0	0.0
2003	30.0	22.4	0.0
2004	30.0	29.0	0.0
2005	30.0	120.0	109.9
2006	40.1	40.1	19.1
2007	58.7	53.7	32.6
2008	58.7	155.7	136.9
2009	36.8	172.8	166.9
2010	35.9	130.5	128.4
2011	32.1	185.8	147.6

Currently there are 34 boats licensed to operate in this fishery but there is no fishing activity in the area of the proposed ferry crossing or in Carlingford Lough. The fishery has shown some level of recovery in the last few years but is still well short of the catches recorded in the 1980s (G Griffiths, DARD, *pers comm*). Landings from the fishery in recent years against the quota allocation (total allowable catch) are shown in Table 7.3.3. The opening quota allocations remain at a low level while end-year quota allocations take into account any quota swaps for that year e.g. from the year 2005 onwards.

Other fishing activity

There is some dredging for “free” mussel in Carlingford Lough i.e. mussel not located on licensed growing areas. Annual landings of up to 55 tonnes have been recorded in recent years (Table 7.3.2).

7.3.3.6 Seabird forage species

Carlingford Lough SPA is designated for breeding populations of Tern which nest on Green Island. These birds feed on fish in the immediate vicinity of Green Island but also throughout the Lough. Lesser sandeel (*Ammodytes tobianus*) are known to be present in the Lough (L Cunningham, *pers comm*) and probably occupy the sandy areas of seabed in the Greencastle area and further into the Lough. Sandeel are likely to form a significant part of the tern’s diet, along with other species such as sprat (*Sprattus sprattus*) and herring (*Clupea harengus*) fry.

7.3.3.7 Sea Angling

Carlingford Lough is increasing in popularity as a sea angling venue with good quality boat fishing and shore fishing available. The Lough has become well known for its tope fishing, which usually begins towards the end of April and runs through to September. The fishery is largely based on male fish in the 25 lbs to 35 lbs (11.34kgs – 15.88kgs) range, but a number of female fish up to 60 lbs (27.22kgs) are encountered and the Irish Record was broken in 1979 with a fish of 66.5 lbs (30.16kgs). Thornback ray, spurdog and dogfish are also common in the Lough while outside, in the deeper water south of Greenore Point, wrasse, pouting, codling and dabs also feature. A noted location is the “Black Hole” just off Greencastle Point.

7.3.3.8 Shore Fishing

The shore around the lighthouse at Greenore is productive for a range of species including mackerel, bass, sea trout, pollack, spurdog, ray and dogfish. Ballagan Point to the south of Greenore is also a noted location for mackerel, bass, pollack, flounder, rockling, dogfish, conger and ray.

Carlingford village produces good catches of mackerel in summer, with flounder and whiting in winter. Other noted venues are Cranfield Point and Greencastle Point with a range of species available. Saltwater fly fishing has become very popular in the area notably for bass during the latter part of the summer.

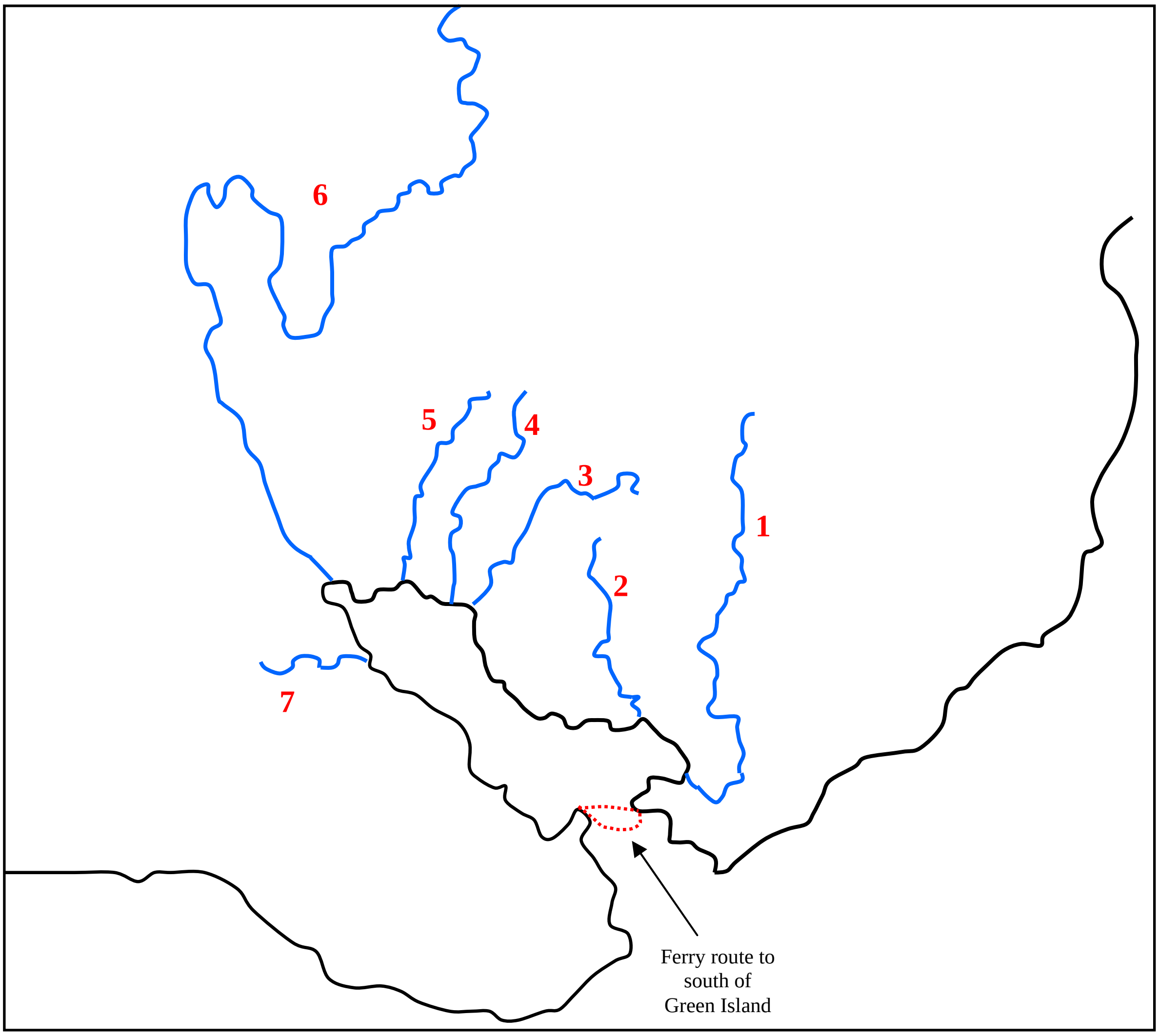
7.3.3.9 Boat Fishing

There are three specialist charter boat operators in the area with boats based in Warrenpoint and Carlingford. The main fish species taken are ray, spurdog, tope and dogfish along with mackerel, codling, coalfish, pollack and conger.

7.3.3.10 Migratory Salmonids

There are a number of rivers discharging to Carlingford Lough, all of which support one or both of the migratory salmonids species, salmon *Salmo salar* and sea trout *Salmo trutta* (Figure 7.29).

Figure 7.29: Salmonid Rivers Draining to Carlingford Lough (1 White Water; 2 Cassy Water; 3 Kilbroney River; 4 Ghann River; 5 Moygannon River; 6 Newry/Clanrye River; 7 Ryland River)



The most important river in the area is the White Water all of which is noted as a high quality sea trout fishery. The White Water is managed by the Kilkeel Angling Club which leases the fishery from the Kilmorey Estate. Other significant rivers are the Newry/Clanrye, Moygannon, Kilbroney, Cassy and Ghann rivers in NI, and Ryland River in ROI, most of which receive small runs of sea trout runs and occasional salmon.

The main stem channel of the Newry/Clanrye River up to Rathfriland was designated as “salmonid” under the Surface Waters (Fish Life Classification) Regulations (Northern Ireland) 1997, which implements the EC Freshwater Fish Directive (Consolidated) 2006/44/EC. In 2003 the designation of freshwaters was extended significantly to include all of the Clanrye as “salmonid” along with the Moygannon, Kilbroney and Cassy rivers.

Juvenile trout and salmon leave the freshwater environment as smolts at age 1, 2 or 3 during the months of April to June. After at least a year at sea both species return to their natal rivers from mid-June to September in order to spawn. During these migration phases the smolts and adult fish must swim through the entrance to Carlingford Lough and therefore directly through the route of the proposed ferry crossing.

Atlantic salmon is one of the species listed in Annex 2 of the Habitats Directive and EU member states therefore have a special obligation to ensure the adequate protection of the species. Populations in many rivers in both NI and ROI are below safe conservation limits due largely to a significant decline in survival of the species during the marine phase of its life cycle. In order to conserve stocks a salmon net buy-out scheme for NI was implemented by DCAL during 2001-2004, and more than 90% of the coastal salmon nets have been removed, including 4 of the 6 nets which operated in the Kilkeel and Newcastle areas.

There is therefore no longer a serious commercial fishery for salmon and sea trout but both species are of economic importance in terms of their value to the recreational and tourist angling sector in local rivers. However stocks have continued to decline and in 2012 most angling clubs in NI responded to a call from the DCAL Minister to release any salmon caught during fishing.

7.3.4 Impact Assessment

Impacts are assessed for the construction and operational phases of the project. Construction impacts are considered to be short term and cover sediment transport, noise/vibration from piling, and the release of other polluting materials. Impacts during the operational phase are viewed as long term and include sediment transport, the release of other polluting materials, and noise/vibration from the car ferry.

Impact assessment is focused on effect on cultivated shellfish at licensed sites in the Lough, and potential effects on migratory salmonids moving to and from freshwater systems within the Carlingford catchment are also considered.

The significance of individual impacts is rated according to the following criteria:

- **Major significance** – effects of the development of greater than local scale.
- **Moderate significance** – effects of the development that may be judged to be important at a local scale (i.e. in the planning context).
- **Minor significance** – effects of low importance in the decision-making process.
- **Negligible** - effects that are of such low importance that they are not material to decision-making.

In-Combination Effects
All potential impacts have been addressed both independently and with regards to any other project or plan listed in Chapter 3 which together may adversely affect fisheries and aquaculture.

7.3.4.1 Construction Phase (Short Term Impacts)

The project has been designed to require minimal site disturbance at each ferry terminal (Greenore and Greencastle) and to utilise the natural seabed depths at each location. Potential effects considered during the construction phase are mainly associated with the release of sediments during site excavations and piling, noise generated during piling, and the possible release of pollutants into the aquatic environment.

Suspension and deposition of sediments

Elevations in the concentration of suspended solids can be a potential problem during the construction phase of any marine engineering project with the potential to impact on both finfish and shellfish populations. Initially an elevation of suspended solids concentrations in the water column can interfere with the gas exchange capabilities in fish, while subsequent settlement of sediments on the seabed can result in the burial and smothering of epifaunal species including lobster and crab. Cultured shellfish are clearly a major consideration with regard to the transport and deposition of sediments which can have an impact on the production and quality of cultured shellfish through impairment of respiration and filter-feeding.

With regard to bivalve shellfish, any factor that slows the rate if larval development may detrimentally affect the level of recruitment to the adult population. However in Carlingford the cultured oyster is brought through these stages in hatcheries while mussel are introduced as seed from known mussel seed areas. The principal concern therefore relates to adult shellfish and, although bivalves are silt-tolerant organisms, their survival in naturally silty areas does not necessarily indicate they are unaffected by high concentrations of suspended sediment. Wilber & Clarke (2001) have reviewed the effects of suspended sediments and note that the primary mechanisms used by adult bivalves to deal with high concentrations of suspended sediment include reducing their net pumping rates and rejecting excess filtered material as pseudofaeces. They also note that when suspended sediment concentrations exceed the threshold at which bivalves can effectively filter material, the available food is diluted.

The impacts of suspended sediments on salmonids have been outlined by Bilotta and Brazier (2008) who note that there are a range of potential impacts. Much of the research has focussed on the deposition of sediments in spawning areas of rivers and its impact on development on eggs and fry, which does not apply in this estuarine situation. Increased concentrations of suspended solids in the water column can act directly on fish through clogging of the gills and causing abrasion to the delicate gill structures (Cordone & Kelley, 1961; Ellis, 1944: Kemp, 1949). It has also been noted that excessive suspended sediments can lead to stress in fish and suppression of the immune system, leading to increased susceptibility to disease and osmotic dysfunction (Ellis, 1981; Redding & Schreck, 1983; Redding et al, 1987). Furthermore it is reported that elevated suspended sediments can interfere with the natural movements and migrations of salmonids (Bisson & Bilby, 2002; Whitman et al, 1982), while Alabaster & Lloyd (1982) have noted that high levels of suspended sediments may reduce the abundance of food available to fish.

The works associated with this project have been designed to minimise potential disruption to the natural sediment transport regime in Carlingford Lough. However, construction of the slipways will involve excavation and physical disturbance to small areas of seabed and adjoining beach at each terminal, and this will have the potential for the release of some sediment to the Lough. There will therefore be some potential for a temporary increase in suspended solids in the water column with the associated risk of sediment transport and deposition in sensitive areas such as shellfish production sites.

Modelling of tidal flows is described in Chapter 9 Coastal Processes, and illustrates that tidal flows are strongly bi-directional in the proposed construction areas, with flood flows occurring in the north-westerly direction and the largest current speeds being experienced north of Greenore Point. The residual currents show a circulatory pattern on the east shore of Greenore Point, as flow is deflected around the headland on the ebb tide. This would suggest that any sediment release at a particular time or over a period will be dispersed by tidal currents into or out of the Lough depending on the state of the tide. However the residual circulatory pattern would suggest that there is a tendency for materials to be deposited along the shore south of Greenore Point, although this will not be significant.

- Although it is predicted that sediment transport along the shoreline south of Greenore Point would be affected to some degree, the effects on local aquaculture and fisheries interests are likely to be of **Negligible Significance**.

Noise and Vibration from Piling

The works will include the driving of tubular steel piles in the marine zone at both Greenore and Greencastle with additional steel sheet piles around the outer perimeter of the slipway at Greenore. This is likely to be carried out by *Impact Piling* which is performed using a metal ram to repeatedly strike the pile, each time driving it an increment into the seabed or ground materials. The procedure will result in the generation of noise and vibration through the aquatic medium with the potential to impact on marine organisms including finfish and shellfish.

Fish can hear noise and sense vibration through the inner ear and the swim-bladder. However many families which possess a swim-bladder during their early life stages have lost it as adults e.g. flatfish and many elasmobranchs.

The effects of pile driving on fish have been reviewed by Hastings & Popper (2005) - there have been no definitive studies on this issue and therefore no clear guidelines on likely impacts, but a limited number of grey literature reports note that different species of fish can be killed within close range of pile driving activity (Abbott & Bing-Sawyer 2002; Caltrans 2004). On the other hand, these reports and other investigations (Nedwell et al. 2003; Abbott 2004), suggest that further from the source fish mortalities are unlikely.

Hastings & Popper (2005) also report that there is no reliable information available on the potential non-lethal effects of pile driving on fish. However a study by Marty (2004) using histological preparation and procedures on fish held in cages 10m from pile driving activity showed that there was no damage to tissue and internal organs.

Salmon are relatively insensitive to sound (Nedwell et al, 2003), responding only to low frequency sounds in the frequency range <1 - 300Hz (Hawkins & Johnstone, 1978) with best sensitivity of 100dB at 150Hz, although they do have good sound and frequency and intensity discrimination, and can discriminate sounds of different frequencies and levels over ambient noise (Hawkins & Johnstone, 1978).

A study by Nedwell et al (2003) looked at the effects of waterborne sound from impact and vibropiling of underwater piling on brown trout in cages in Southampton Water. (Brown trout *Salmo trutta* were used as a model for salmon, which were the species of interest but were not readily available). No obvious signs of trauma that could be attributed to sound exposure were found in any fish examined, and no increase in activity or startle response was seen to vibropiling. During impact piling, the noise at the nearest cages reached levels at which salmon were expected to react strongly, but the brown trout showed little reaction. An audiogram of the brown trout was measured by the Auditory Brainstem Response method, which indicated that the hearing of the brown trout was actually less sensitive than that of the salmon. However in the case of the current ES/EIS, this is a valid observation with reference to salmon and sea trout which are likely to have a similar level of sensitivity.

In another study the pile driving associated with the removal and reconstruction of a harbour jetty adjacent to an important Atlantic salmon river in Scotland was monitored by Hawkins (2006), the main concern again being the impact of resultant noise on salmon migrating through the lower part of the river estuary. Both Impact piling and Vibro-piling were found to generate high sound levels in the water which could have been detected by salmon at considerable distances from the source. It was concluded that the sound pressure levels (SPLs) and sound exposure levels (SELs) generated by impact pile driving were not likely to have killed fish, but close to the pile driver would have been high enough to injure or induce hearing loss in some species of fish. As salmon could not be observed during the exercise, it was not possible to determine whether they reacted adversely to the noise generated, but there was a risk that their upstream migration may have been delayed or prevented with consequent effects upon spawning populations.

Therefore, although salmon and trout are relatively insensitive to sound, it seems likely that the noise levels generated by piling operations at Greenore and Greencastle could be detected by fish at some distance from the source. Within the confines of the channel at this point this could interfere with migrations of smolts to sea during April/May and returning adult fish from July to October. Sandeel spawning in the immediate area during the summer months could also potentially be disrupted by piling operations.

There have been relatively few studies describing the effects of noise on invertebrates but the general view is that there are very few effects, behavioural or physiological, unless the organisms are very close to a powerful noise source (Vella et al, 2001). It is therefore concluded that there will be no impact on shellfish from noise generated by piling.

- The effects on salmonid migrations in this area of Carlingford Lough could be of moderate significance, but the effect on shellfish is predicted to be of **Negligible Significance.**

Release of Polluting Materials

As the works will be carried out within and directly adjacent to the Lough, there is some potential for spillage or release of diesel, oil or other polluting substances into the aquatic environment with potential effects resident fish and shellfish.

Similarly the application of cement and concrete materials in construction of the slipways at each terminal carries some risk of inadvertent discharge with the potential to impact on aquatic organisms. Un-cured concrete and cement is highly alkaline and could have localised effects on water quality.

- Without mitigation a serious spillage of toxic material could potentially be of **Major Significance.**

General Comment - Aquaculture

Apart from the risk of pollution the general effects on aquaculture during construction are likely to be negligible.

- No impact.

General Comment - Pot Fisheries

There will be no impact on pot fishing operations as there is only limited activity in this area of Carlingford Lough. There is unlikely to be disturbance to larval/juvenile habitats as only the intertidal area at both terminal locations will be effected during construction.

- No impact.

General Comment - Herring

All herring fishing activity takes place outwith the lough and the main herring spawning area is well defined as within the Mourne Box off the Co Down coast. There will therefore be no effect on the herring fishery.

- No impact.

General Comment - Seabird Forage Species

Noted as the principal forage species of tern, sandeel are likely to occupy sandy sub-littoral areas near the construction sites, notably in the Greencastle area - some minor localised disruption is possible during construction activity at this site.

- Without mitigation the effects on seabird forage species are likely to be of Minor Significance.

General Comment - Sea Angling

Greenore Point in the area of the lighthouse has been noted as a popular shore fishing location. Angling may be disrupted to some degree in the immediate area of the terminal during the construction phase.

- The effects on sea angling are likely to be of **Minor Significance**.

7.3.4.2 Operational Phase (Long Term Impacts)

Sediment Transport

The impacts of suspended sediments and deposition of sediments have been outlined under impacts during the construction phase (7.3.4.1). However any alteration in the pattern of sediment transport resulting from the slipway construction at either terminal could have the potential for longer term impacts during the operational phase of the project.

Tidal modelling (Ch 9 Coastal Processes) has indicated that resultant changes in bathymetry did have some effect on tidal flows, but this was limited to the immediate vicinity of the development and did not alter the wider tidal flow pattern. Assessment of littoral currents under relatively severe events and the presence of the ferry infrastructure showed that sediment transport along the shoreline south of Greenore Point would be affected to a greater degree and the overall area of impact will extend 400m along the east shoreline. This should not have any impact on the nearest aquaculture site which is located approximately 1 km in this direction from Greenore Point.

- Although it is predicted that sediment transport along the shoreline south of Greenore Point would be affected to some degree, the long term effects on local aquaculture and fisheries interests are likely to be of **Negligible Significance.**

Release of Polluting Materials

Operation of the ferry and the two terminals will carry an inherent risk of pollution of the Lough from the release of oils, fuels and any chemicals used, with potential impacts on shellfish health and growth. These have been outlined in Chapter 8 Water Environment and include:

- the storage of chemicals, fuels and oils
- refuelling activities
- maintenance works

The use of antifouling agents on the ferry hull has also been considered in Section 7.1 Benthic Ecology which concludes that resultant impacts in this open well-mixed environment are likely to be negligible.

- Without mitigation a serious spillage of toxic material could potentially be of **Major Significance.**

Noise Generated by the Car Ferry

The hearing and sensitivity response of many fish species overlaps to an extent, with noise in the marine environment from anthropogenic sources such as shipping or engineering activity (Vella et al 2001).

Noise generated by larger boats is a combination of tonal sounds at specific frequencies (e.g. from propeller blades) and broadband noise - it should be considered as a continuous noise source as opposed to a transient source. Propeller cavitation noise is the primary source of sound while noise generated from propulsion machinery originates inside a vessel and reaches the water via the hull.

Larger vessels have more powerful and slower-turning engines and propellers, while larger hull areas have greater potential to transfer machinery sound from within to the surrounding water. Therefore, in general, the bigger the vessel the higher the level of noise generated and the lower the dominant frequency range of this noise. Moreover, for a vessel of a particular size, the level of noise increases with the speed of travel.

Vessel noise covers a wide range of frequencies from 10Hz to 10kHz. Noise levels and dominant frequencies for different vessel types have been outlined by Vella et al (2001) - a source level of 162dB at 630Hz is described for a tug/barge travelling at 18 km/hr. It is assumed that this would approximate to the noise levels likely to be generated by the car ferry.

It has been noted above that salmonids are relatively insensitive to sound and respond only to low frequency sounds in the frequency range <1 - 300Hz (Hawkins & Johnstone, 1978). It would appear therefore that the level of noise produced by the car ferry is likely to be outside the range of the salmon's hearing ability.

A similar sized car ferry has operated intermittently over the last 10-15 years across the entrance to Lough Foyle between Magilligan (Co Derry) and Greencastle (Co Donegal). The entrance to Lough Foyle is a slightly narrower channel and concentrations of migratory salmon and trout are likely to be much higher than at the Carlingford route. However this service has operated without any apparent impact on fish migrations of salmon and trout.

It has already been noted (7.3.9.2) that noise does not appear to impact on the behaviour or physiology of invertebrates which would include shellfish.

- The long term effects on fish and shellfish of noise generated by the car ferry are predicted to be of **Negligible Significance.**

General Comment - Aquaculture

Operation of the ferry is unlikely to have any long term effects on aquaculture.

- No impact.

General Comment - Pot Fisheries

There will be no long term effects on pot fishing operations as there is only limited activity in this area of Carlingford Lough.

- No impact.

General Comment - Herring

Operation of the ferry will have no long term effects on the herring fishery which is located outwith Carlingford Lough.

- No impact.

General Comment - Seabird Forage Species

Operation of the ferry will have no long term effects on seabird forage species, notably the Lesser sandeel.

- Without mitigation the effects on seabird forage species are likely to be of Minor Significance.

General Comment - Sea Angling

The presence of the slipway at Greenore Point will result in some restriction of shore angling in the immediate area due to the presence of the new infrastructure. However this should not impair the potential and popularity of the location as a sea angling venue.

- The effects on sea angling are likely to be of **Minor Significance**.

7.3.5 Mitigation

7.3.5.1 Construction stage

Mitigation measures with regard to reducing the risk of pollution during the construction process are outlined in some detail in Chapter 8 (Water Environment) and these will clearly apply to the potential impacts described in this chapter which relate to fisheries and aquaculture. Mitigation focuses on an

Construction stage Environmental Management Plan (CEMP) for the project which will be prepared by eventual Environmental Coordinators for the project and the appointed Contractor.

The CEMP will include the appropriate Pollution Prevention Guidelines (PPGs) which are produced jointly by the Environment Agency for England and Wales, the Northern Ireland Environment Agency (NIEA) for Northern Ireland and the Scottish Environment Protection Agency (SEPA). These guidelines provide practical advice to avoid causing pollution, minimise waste and comply with the requirements of the law.

Suspension and deposition of sediments
Procedures to minimise the risk of releasing suspended sediments to the aquatic environment will be based on:

- PPG 1 General guide to the prevention of pollution of controlled waters
- PPG 5 Works in, near or liable to affect watercourses
- PPG 6 Working at demolition & construction sites

Noise and Vibration from Piling
Some authors have suggested that a bubble curtain can be effective in mitigating the effects of piling by partly dissipating the noise produced (Keevin et al, 1997; Würsig et al, 2003). Hawkins (2006) has reported the use of this method in successfully reducing the peak amplitude of the sound from piling and in reducing the high frequency content of the sound. However these systems tend to be costly and could be difficult to deploy effectively at these locations due to the strong directional tidal flows of the estuary channel dispersing the bubble flow, particularly at Greenore Point. It is also likely that the vibration impact would be partially transmitted through the bed of the channel and this aspect would not be reduced by a bubble curtain.

To minimise the impacts of piling and dredging on salmonid fish at the development site it will be more effective to schedule these operations during periods when salmon and sea trout are least likely to be present in the estuary. The proposed work programme suggests that piling operations will take up to six months to complete, although some elements may overlap thereby reducing the overall time requirement..

Throughout the annual cycle there are 3 key salmonid migrations through the estuary:

- April / May - out-migration of salmon and sea trout smolts
- July - October - return of adult salmon and sea trout

Ideally the piling operations associated with construction should therefore be carried out between November and March to avoid interference with these migrations. This would also remove the potential for any disruption to the sandeel spawning period during the summer months.

Release of Polluting Materials
Procedures to minimise the risk of releasing polluting materials to the aquatic environment will be based on:

- PPG 1 General guide to the prevention of pollution of controlled waters
- PPG 5 Works in, near or liable to affect watercourses
- PPG 6 Working at demolition & construction sites

The guidelines outlined in CIRIA document “Control of Water Pollution from Construction Sites – Guide to Good Practice” will also be appropriate in achieving these objectives.

7.3.5.2 Operational Stage

No capital mitigation measures will be required during the operational phase as long term impacts are predicted to be minimal.

Sediment Transport

Tidal modelling has indicated that sediment transport along the shoreline south of Greenore Point will be affected to some degree but this will not require any specific mitigation.

- No mitigation required

Noise Generated by Car Ferry

Although operation of the car ferry will represent a significant increase in boat traffic at the mouth of the lough, it is unlikely to interfere with movements of salmon and sea trout, and this will not require any specific mitigation.

- No mitigation required

Release of Polluting Materials

The prevention of pollution will require the application of appropriate management and maintenance practices with regard to the ferry and the two terminals as outlined in Chapter 8 (Water Environment). Specifically this will include:

- Handling of fuels, oils and chemicals in accordance with relevant PPGs and legislative requirements in both jurisdictions.
- Regular inspection of condition of oil, fuel and chemical storage/refuelling facilities and equipment, along with routine maintenance to minimise the risk of leaks.
- Maintenance works to be carried out in accordance with relevant best practice guidance available at that time.

7.3.6 Residual Impacts

- In the worst case scenario and without mitigation, the overall impact of the proposed development on Fisheries and Aquaculture interests could be anywhere in the range of **Minor to Major Significance**.

- However, provided the mitigation recommendations are implemented as outlined, the general impact should be **Neutral** or of **Negligible Significance**.

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